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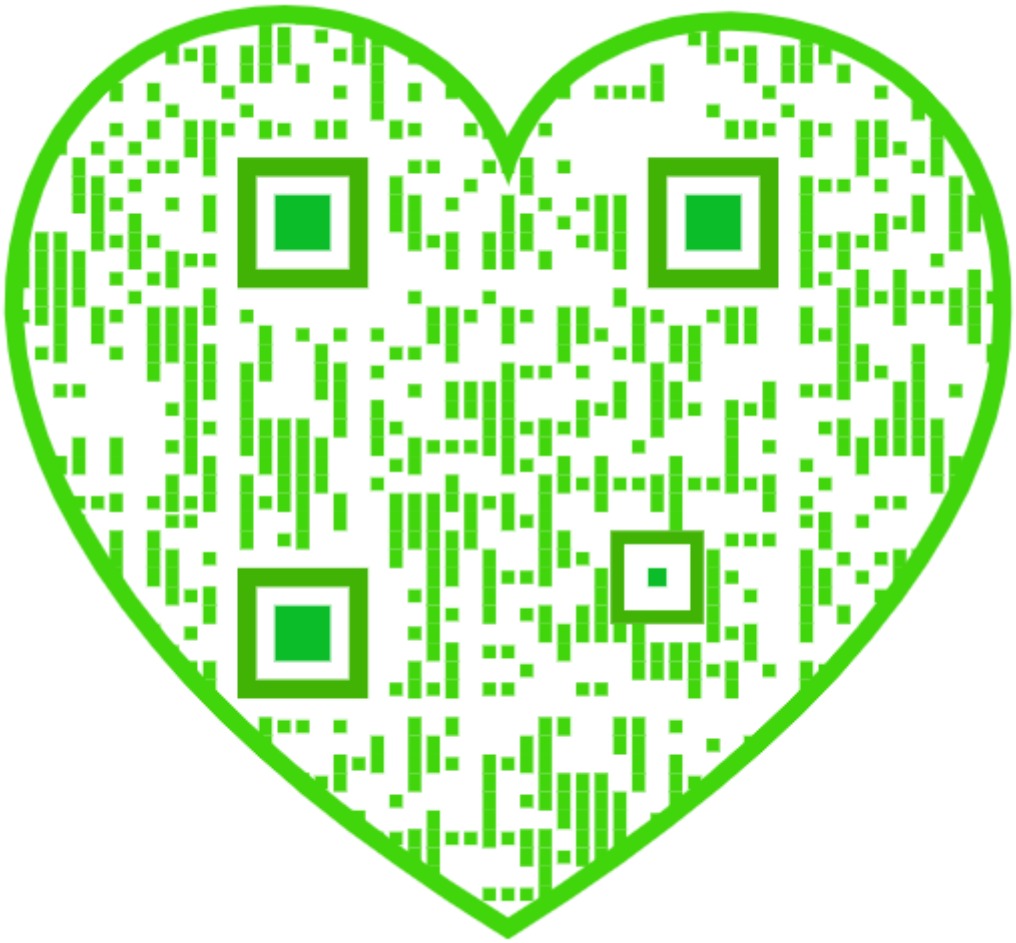
BEGINNING WOODWORK

AT HOME AND IN SCHOOL

—BY—

CLINTON SHELDON VAN DEUSEN



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BEGINNING WOODWORK

AT HOME AND IN SCHOOL

By

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FOREWORD

This book is intended as a definite statement of steps that may be followed by a beginner in learning the fundamental principles of woodworking. Instead of giving a general discussion of woodworking processes, the book describes and illustrates principles by means of specific examples. The experience gained in doing these problems should enable one to master a large number of others of which these stand as types.

It is believed that this method of treatment of the subject of woodworking will prove helpful in both school and home work.

Clinton S. Van Deusen.

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BEGINNING WOODWORK
AT HOME AND IN SCHOOL

CHAPTER I.

INTRODUCTION.

Shop. Before beginning the work outlined in this book it will be necessary to have what we will call a shop in which to do the work. This may be quite an elaborate building, but necessity demands only a few square feet of floor space for the work, and even if this be in the corner of a room used for some other purpose, it need not prevent the doing of excellent work. It is desirable that the shop be well lighted and ventilated, and if it is possible to have light from only one direction, it is best to have it come from the left end of the bench.

Bench. A bench with a vise is necessary for supporting the work, and while it is possible to use a crude home-made bench and vise, a bench such as is used in manual-training shops (Fig. 1) is more desirable. These can now be purchased at a reasonable price, and with careful treatment will last a lifetime. When their permanent value is considered, the first cost is a wise investment. The bench should be fastened to the floor by two lag-screws passing through the middle of the foot-pieces.

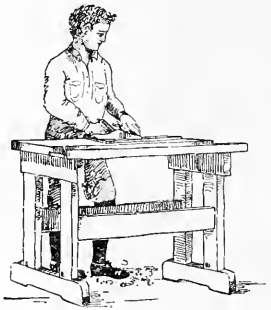


Fig. 1

Vise. A good vise is a very important item; a cheap one, that might last under the careful treatment of an experienced workman, will not withstand the treatment of a beginner. A good rule to follow in using a vise is to see how loose a piece can be clamped and still be held in place. This method is better for both the vise and the work, as tight clamping may injure the vise and is also liable to mar the work. Vises are made of either wood or metal and consist of two jaws which are opened and closed by a wooden or iron screw, turned by a handle that passes through an eye in the outer end of the screw. A modern invention known as a rapid-acting vise, Fig. 18, consists of the same essential parts, but by bringing the handle to a vertical position the outer jaw may be moved away from the inner jaw far enough to admit the piece which is to be held, and then, by turning the handle to the right, the outer jaw is moved toward the inner and the piece is fastened securely in the vise. It should be remembered that a vise is a machine, and therefore the metal parts that rub together should be lubricated occasionally with a little oil, or in case a vise with a wooden screw is used, a little melted beeswax rubbed on the screw will cause it to work more freely.

Tools. A good workman learns to feel toward and care for his tools as if they were his pets, and it should be the purpose of the beginner to give so much care to his tools that they will have no opportunity to drop from the bench or come in contact with metal objects, such as parts of the vise, bench stop, etc. Some offer

as an objection to a metal vise that tools are liable to become injured by coming in contact with it, but care on the part of the worker will prevent such an accident. A place should be provided for each tool and *it should be kept in that place when not in use.* If tools are not to be used for a month or more, the bright steel surfaces should be coated with vaseline to prevent their rusting. When a tool becomes dull do not delay sharpening it, as more time is lost in using a dull tool than is required to sharpen it. The method used in sharpening chisels and plane irons is explained in the Appendix. A workman should acquire ability to keep these tools in good condition. The sharpening of saws is not considered within the province of this book, but do not work with a dull one; have it sharpened by some one who knows how. One more rule should be enforced and that is to have a barrel, box or bag in which to keep shavings, and to regularly clean up the shop.

A list of the tools necessary in doing the work outlined in this book may be found in the Appendix, page 97.

Material. One must work with each particular kind of lumber in order to acquire a knowledge of its qualities. For this reason, it is proposed to use six varieties of lumber in the problems described in this book. Each is especially suited to the problem in which it is used. Other kinds might be substituted, but not without sacrificing some of the advantages of the work. Lumber to be in good condition for working should be well seasoned; that is, a large part of the sap that was in the wood when the tree was standing should be removed.

Fig. 2

Fig 3

Fig 4

Seasoned lumber will absorb moisture if kept in a damp place; therefore it is best to keep it in a dry place. If the entire amount listed in the Appendix (page 98) is purchased at one time, it is advisable to pile it in layers with an air space between the pieces and with adjacent layers extending at right angles to each other. If piled in the reverse order from the list given, each piece may be removed from the top of the pile as needed.

A box should be provided in which to keep nails, screws, etc., and at no time should they be left loose on the bench or in other places where tools might be brought in contact with them and thus become injured.

A list of the material necessary in carrying out the work outlined is given in the Appendix, page 98.

Working Drawings. It is as important that a workman should understand working drawings as it is that a correspondent should understand the language of a letter he has received. A brief explanation will give some of the underlying principles of working drawings:

If the first piece mentioned in the list of lumber be laid on a table it might appear as in either Fig. 2, 3 or 4, depending on the position taken by the observer. On account of this variation in the appearance of the same object from different viewpoints, this method is not very satisfactory for conveying definite information in regard to any piece that is to be made, and therefore a plan that is quite different in many respects is in use. Now consider the same

piece with a piece of paper folded as in Fig. 5, so as to form a vertical plane in front of the piece and a horizontal plane above it. A rectangle might now be drawn on the vertical plane as shown at S, Fig. 5, the sides of which will be directly in front of the edges of the piece that is back of the plane. This rectangle would be known as the front view of the piece. In a similar manner a rectangle might be drawn as shown by short dash lines at T, Fig. 5, on the horizontal plane, of such a size and in such a position that its sides would be directly over the edges of the piece. This rectangle is known as the top view of the piece, and if the horizontal part of the paper should now be brought into a vertical position and dimensions added[1] we would have what is known as the working drawing of this piece. It shows to the workman definitely the form and size of the piece and is typical of a large class of working drawings in which only the top and front views of the piece are shown.

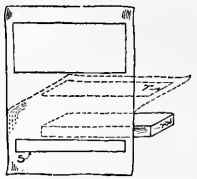


Fig. 5

Now if one should make a working drawing, in the manner explained above, of a cylinder having its axis horizontal and parallel to the front, he would find that the drawing would not convey a complete and correct idea of the form of the cylinder and some other method must be resorted to. In this case it is desirable to consider the paper folded as in Fig. 6, so as to form two vertical planes, one in front of the object and the other extending back and at right angles to the front plane. The front view is a rectangle (U, Fig. 6) on the front plane, whose sides are directly in front of the edges and of the upper and

[1] Dimensions are omitted in Fig. 5 for simplicity but the method of placing them may be seen in Fig. 7.

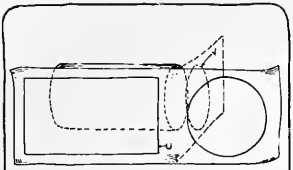


Fig. 6

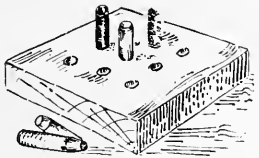
lower limits of the cylinder. On the vertical plane at the side a circle might be drawn as shown by short dash lines at V, Fig. 6, that would be directly in line with the edges of the cylinder. This would be called the side view, and when this part of the paper is brought again in line with the paper in front of the cylinder, and dimensions placed on it, we have a working drawing which is typical of another large class of drawings in which only the front and side views are shown. In making working drawings, edges or limits of objects obscured from view by parts of the object itself are shown by lines made up of short dashes. Thus the fact that the holes go entirely through the game board is shown by the dash lines on the front view in Fig. 7.

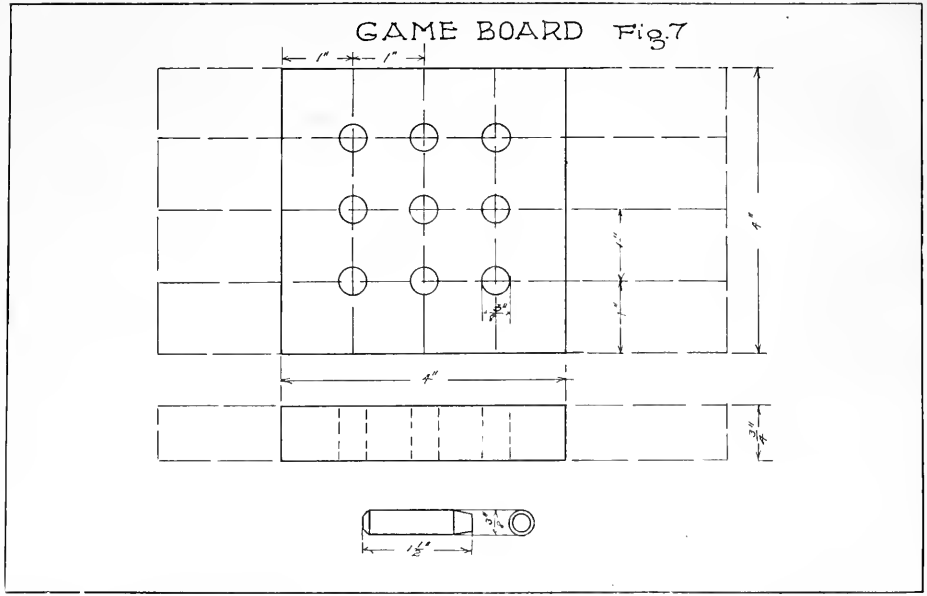
A method frequently employed in working drawings is what is known as taking a section and if its use is understood the drawing is usually clearer. This method consists in imagining a part or all of an object cut by an assumed plane and the parts thus cut exposed to view. To indicate the surface of a piece or pieces that are cut by such a plane, uniformly spaced slanting lines are drawn across the part supposed to be cut. When more than one piece is cut, the lines in adjacent pieces slant in different directions. The use of sections is illustrated in Fig. 41 where an imaginary cut made through the middle of the coat hanger shows its form without the necessity of showing the end view.

Another method frequently resorted to in making working drawings is to imagine a part of the object cut away so as to expose

parts that are in reality covered. This frequently allows the details of the construction to be shown more clearly than would otherwise be possible. In the working drawing of the taboret (Fig. 74), this method is used, a portion of the top being removed to show the form and method of joining the legs and braces below.

Frequently it is not convient to make drawings the full size of the object represented and in such cases the drawings are made to scale; that is, they are made one-half, one-fourth, or some other definite part of the full size.




GAME BOARD Fig.7
1"
1"
4"
4"
3/4"

CHAPTER II.

Laying Out and Sawing.

This first problem is to give experience in good methods of laying out work, sawing, boring and the use of the dowel plate.

Game Board. The material required is a piece of tulip wood 8″ long, planed by machine to a width of 4″ and a thickness of $\frac{3}{4}$″, another piece of the same dimensions to use in practice work, and two pieces of straight-grain tulip wood about 18″ long and $\frac{7}{16}$″ square for the pegs.

The tools required are a pencil, a marking gage, a knife, a try-square, a rule, a bench-hook, a back-saw, a brace, a $\frac{3}{8}$″ auger-bit, a dowel-plate and a mallet.

The working drawing (Fig. 7) should be studied before starting the benchwork and an effort made to determine what is to be the length, width and thickness of the completed piece, where the holes are to be located, etc., and as you proceed with the work it is well to consult the drawing frequently that you may understand the reason for the steps, and thus acquire ability to use a working drawing. Below are given the steps to be followed with details of the methods to be used.[1]

[1]Each paragraph and foot note should be read before starting the work described therein, and then if you have difficulty in following the instructions re-read the paragraph and make sure that you understand it. Technical terms have been avoided as far as possible but if any of those used are not understood the dictionary should be consulted.

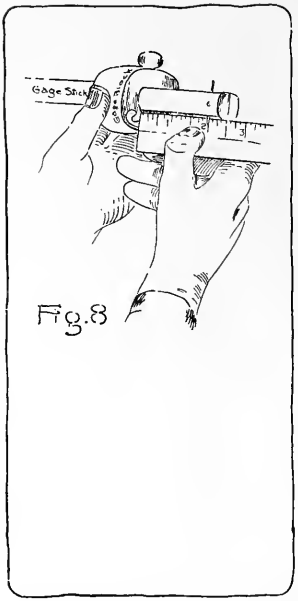


Fig. 8

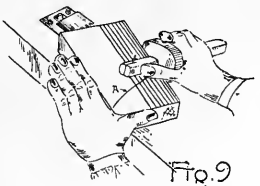


Fig. 9

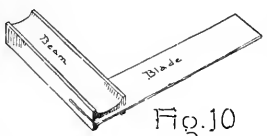


Fig. 10

(a) Select one of the broad surfaces of the practice piece, and with a pencil, mark a light slanting line across it (A, Fig. 9) to designate it as the working face, by which term it will be known in referring to it later.

(b) Select one of the narrow surfaces and mark two light slanting lines across it (B, Fig. 12) to designate it as the joint side.

(c) Practice gaging lines on this piece as follows: Set[1] the gage so that the little metal point is $\frac{1}{8}$″ from the gage-block. Take the gage in the right hand and with the left hand hold the piece against the bench-stop so that the joint side is at the right. Place the gage on the end of the piece which is toward you (Fig. 9) and with the gage-block against the joint side. Now push the gage from you, with the top of the iron pin inclined away from you, and at the same time exert a slight pressure toward the left to keep the gage-block tight against the joint side. Do not grip the gage too tight or keep the wrist too stiff while gaging. Make a very light line the first time across, and then pass the gage over it again making the line to the required depth, which should only be deep enough to make a clear, even line. Now increase the set of the gage by $\frac{1}{8}$″ for each successive line until it is set to $3\frac{1}{2}$″; gage slowly and notice that the gage-block is close against the joint side at all times. If still unable to make good lines, repeat the practice work on the other side of the piece.

(d) Set the gage as in Fig. 8 so that the metal point is exactly 1″

[1]Do not depend on the graduations on the beam of the gage in setting it, but use the rule as shown in Fig. 8.

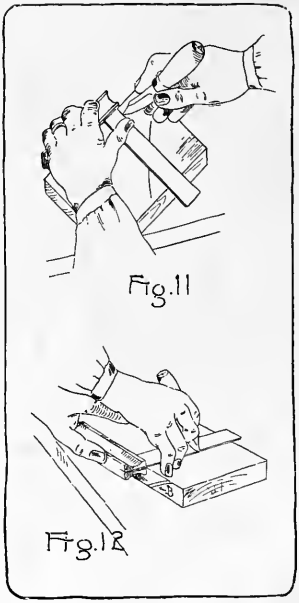
from the gage-block. Mark the working face and joint side on the piece for the game board and hold it against the bench-stop with the working face on top and the joint side at the right. Then with the gage-block against the joint side, gage a line the length of the piece.

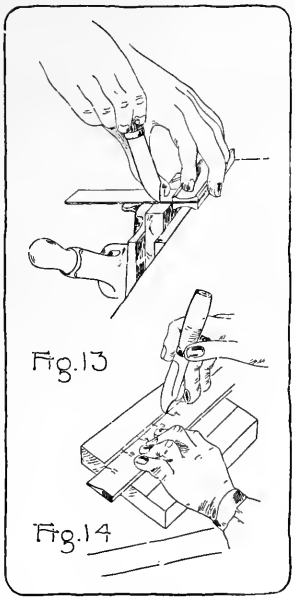
(e) Change the set of the gage to 2″ and gage the length of the piece.

(f) Change the set of the gage to 3″ and gage another line the length of the piece.

(g) Practice drawing knife lines across the practice piece as follows: Place the piece on the bench with the joint side away from you and place the try-square on the piece with the beam (Fig. 10) against the joint side and the blade on the working face and near the right end. Holding it in this position with the left hand, draw a knife line along the edge of the blade with the right hand (Fig. 11). Always draw the knife toward you with the handle inclined slightly away from the blade of the try-square. When the try-square comes so near to the left end that the beam is not well supported, turn the piece around with the joint side toward you and place the try-square on the piece with the beam against the joint side and the blade near the right end (Fig. 12). Draw the line lightly the first time across the piece and the second time draw it to the desired depth.

(h) When able to draw lines well (as explained in g) you should practice drawing knife lines square around the practice piece in the following manner: Draw a knife line across the working face (as explained in g); then place the piece in the vise with the beam of the





try-square held tight against the working face (Fig. 13), and draw a knife line across the joint side, joining exactly with the end of the line drawn first; repeat this on the side opposite the joint side and then with the beam against the joint side draw a line on the surface opposite the working face, joining exactly with the end of the last line drawn. If this work has been done carefully, and the beam in all cases has been held tight against the working face or joint side, this line will also join with the line on the joint side making a continuous line square around the piece.

(i)—Now take the piece for the game board and lay the rule flat on the piece with the graduated edge away from you and parallel to the gage lines (Fig. 14). With the knife held in a vertical position and with the back of the blade against the rule, make light knife marks at five consecutive inch divisions, the nearest of these points being at least $\frac{1}{2}$″ from the end.

(j) Through the three middle points thus marked, draw knife lines across the working face (as in g) and through the two end points thus marked, draw knife line square around the piece (as in h). The two lines drawn last, mark what are to be the ends of the piece when completed.

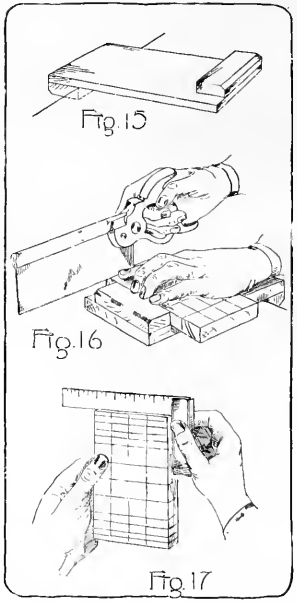
(k) On the surplus wood outside of these lines draw several lines square around the piece (as in h) to use as guide lines for practice sawing. Saw to these lines in the following maner: Place the bench-hook (Fig. 15) on the bench with the larger block hooked against the front side of the bench and, with the left hand, hold the piece against

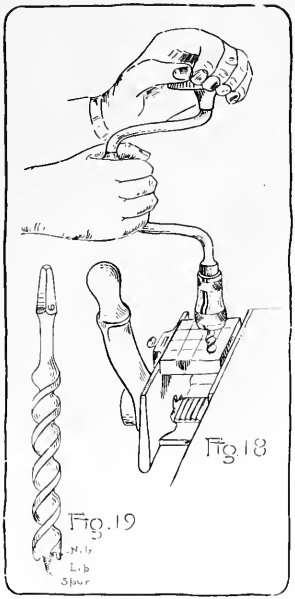
the block on the bench-hook. Take the back saw in your right hand and place the end of the saw nearest your hand on the edge of the piece farthest from you (Fig. 16) and draw the saw toward you with the nearer end of the saw higher than the farther end, the saw blade being held steady in the correct place by resting against the forefinger of your left hand. By drawing the saw toward you a second time before you really start sawing, a fairly deep cut or kerf will be formed, which will prevent the saw jumping out of place as it is pushed forward. The left hand side of this kerf should come exactly to the knife line you are sawing to. Saw with an even stroke but do not press down on the saw. Keep the forearm in line with the saw and watch closely the knife line as the sawing advances, bringing the cutting edge of the saw very gradually to a horizontal position.

(l) After sawing off a piece, test to see if the end is square with the working face and joint side in the following manner: Place the beam of the try-square against the joint side and slide it down until the blade touches the sawed surface (Fig. 17). If it touches entirely across the sawed end when the beam is tight against the joint side, the end is square with the joint side. In a similar manner test to see if the end is square with the working face.

(m) When you can saw well, saw the piece to the length denoted by the end lines drawn square around the piece in j.

(n) Bore a hole $\frac{3}{8}$″ in diameter through the piece at each point where a gage and knife line intersect. By holding the end of the brace (Fig. 18)—the end into which the bit is to be placed—in one hand, it





will be found that by turning the middle part or crank around in one direction the jaws will open and the tapered end of the $\frac{3}{8}$″ auger-bit (Fig. 19) may be dropped between them. The jaws may then be closed tightly on the bit. Fasten the piece in the vise with the working face in a horizontal position. Place the spur of the bit (Fig. 19) exactly at the intersection of gage and knife lines. Hold the bit in a vertical position with the left hand on top of the brace and, with the right hand, turn the crank part of the brace in a clockwise direction as you are looking down on it, but do not press down on the brace (Fig. 18). While boring change your position frequently so as to view the bit and brace from different directions that you may detect if it is not boring straight. When the spur of the bit pricks through the opposite side, turn the piece over and enter the bit in the hole pricked by the spur. Bore out the remainder of the hole, being careful that the bit does not suddenly drop through and splinter the edge of the hole on the opposite surface.

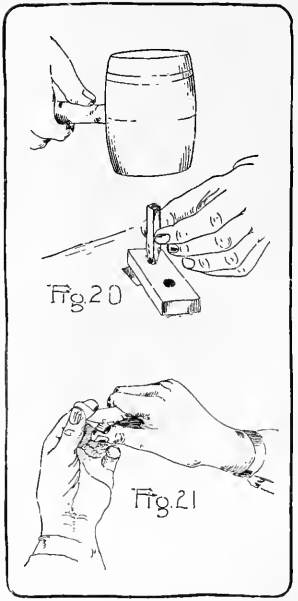
(o) From one of the $\frac{7}{16}$″ square pieces saw off a piece about 2″ long. With the knife make a point on one end of it sufficient to enter it in the larger hole of the dowel plate. Place the dowel plate so that this hole is directly over one of the holes in the top of the bench and with the mallet drive the piece through this hole (Fig. 20), using light strokes. Do not drive the peg back through the hole to get it free from the dowel plate, but whittle a small peg and drive it on through the plate. In a similar manner drive it through the smaller hole which will bring it to a diameter that will fit freely in the holes bored.

Drive at least eight pieces through the dowel plate in this manner, but unless the grain is suitable and the driving done with care it may be necessary to drive more than eight pieces before enough good ones are obtained.

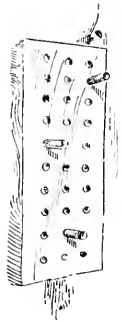
(p) Saw a length of $1\frac{1}{2}$" from the best part of eight of these pieces that have been driven through the dowel plate and with the knife cut off the edges (Fig. 21) of each end of the pegs at as near as possible the slant indicated by the drawing (Fig. 7). It should be remembered that these tapered edges should be in the form of a part of a cone and careless use of the knife may cause them to be a disfigurement to your piece.

(q) Four of these pegs should be dipped in ordinary writing ink and laid on paper to dry. When these are dry the board is ready for playing the game of tit-tat-toe which is familar to all Americans.

In Fig. 22 a working drawing of the counting board is given which requires almost identically the same steps in making as does the game board, but in addition the numbers indicated are necessary. These may be made with steel stencils, rubber stamps or even with a lead pencil. To make use of the counting board it should be fastened to the wall by two nails or screws passing through the small holes at the top and bottom. It may then be used to record any slow counting as the counting of bushels of grain emptied into a bin, the gallons of oil purchased in a year by a family, articles made in a factory, etc. The right hand column of holes corresponds with units, the middle column with tens, and the left hand column with hundreds. As each article is counted

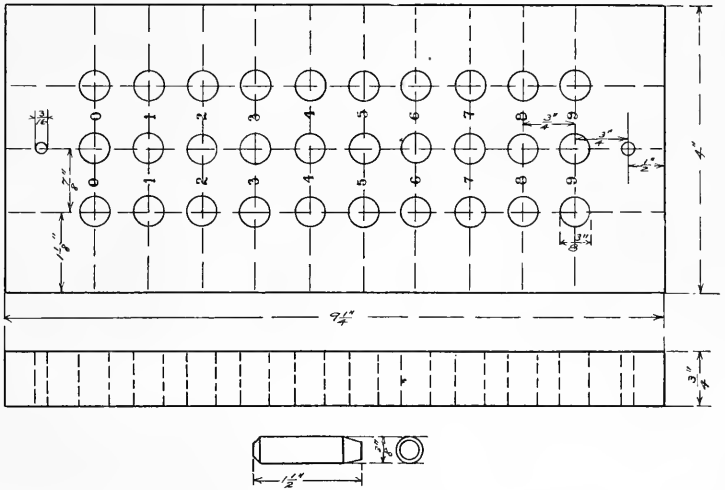


the peg in units column is moved down one hole and as each ten units is completed the units peg is returned to the zero hole and the peg in the tens column is moved down one hole. In a similar manner, as each ten tens is completed the peg in the tens column is returned to zero and the peg in the hundreds column is moved down one hole. The numbers by the side of the three pegs taken in order indicate the count as it stands at any time.



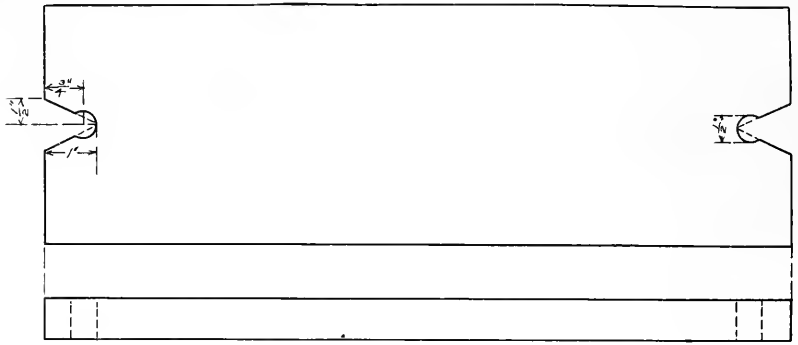
COUNTING BOARD

Fig. 22



SWING BOARD

Fig. 23



CHAPTER III

Planing.

On completing this chapter one should have acquired a free motion when using the jack and block planes; should have become skilled in taking off a shaving where desired; and should have an appreciation of the accuracy possible when using the plane.

Swing Board (Fig. 23). The material required is a piece of rough pine 15″x5″x$^7_8$″.

The tools to be used for the first time are the jack-plane and the block-plane. The jack-plane is about 13″ long, the several parts of which are shown clearly in Fig. 24.[1] The double plane-iron (Fig. 25) may be moved in or out of the mouth by turning the adjusting nut (M Fig. 24) thus regulating the thickness of the shaving that the plane will cut, and by moving the lever (N Fig. 24) that is close under the plane-iron, to the right or left the sharpened end of the plane-iron may be made to project an equal distance out of each end of the mouth (O Fig. 24). When planes are not in use they should be laid on their side or placed in some other position where

[1]The planes shown in Figs. 24 and 26 have been standards for some years but other good planes are now on the market and if purchased by a beginner he should learn the method of adjustment when purchasing. A portion of the appendix is devoted to a further description of these planes, and an explanation of how to take them apart and put them together is given. If your plane is in good condition it is not advisable to read these explanations until after the work of this chapter is completed.

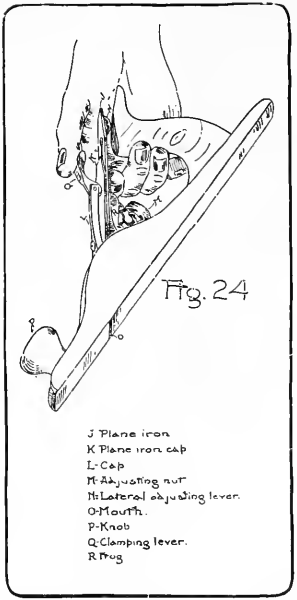


Fig 25

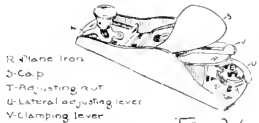


Fig 26

the sharpened end of the plane-iron cannot come in contact with anything, not even the surface of the bench.

The block-plane, the parts of which are shown in Fig. 26 is about 6″ long and is made especially for planing across the end of the wood. The adjusting nut (T Fig. 26) is placed in a different position but changes the thickness of the shaving the same as the adjusting nut in the jack-plane. The lateral adjusting lever (U Fig. 26) serves the same purpose as the one on the jack-plane.

(a) Raise the bench-stop or stops to about half the thickness of the piece for the swing board and place the piece lengthwise of the bench with a broad surface up and one end resting against the bench-stop.

(b) Stand in an erect position with the left foot a little in advance of the right, and with the right side of the body a little back of the right end of the piece (Fig. 1). With the jack-plane set for rather a light cut, place it on the right end of the piece, holding the handle with the right hand and with the left hand resting on the knob at the front end of the plane. Now push the plane forward without much movement of the body; that is, let the arms swing from the shoulders. A downward pressure should be exerted on the knob when beginning the stroke, and when finishing the stroke a downward pressure should be exerted on the handle. In bringing the plane back to begin another stroke raise the plane sufficiently to prevent its drawing the piece back.

(c) Strokes similiar to those described in b should be continued

until the surface appears smooth. It may be desirable some of the time to plane only part of the length of the piece, and that should be done in one of the following ways: if it is desired to plane from near the middle of the piece to the farther end, the plane may be placed on the board where desired and pushed to the end, as the starting of the shaving will be gradual and no disfiguring mark will be left. If, however, it is desired to stop the cut of the plane before reaching the farther end, it is necessary to gradually reduce the thickness of the shaving as it comes to the end of the cut by raising the back end of the plane from the board while the plane is in motion.

(d) When this entire surface appears smooth, mark a light slanting line across it to designate it as the working face.

(e) Clamp the piece in the vise with one of the narrow sides up and hold the plane in a manner similar to that explained in b, except that the fingers of the left hand should be allowed to extend down by the left side of the plane and piece (Fig. 27). When the side is nearly smooth, try the effect of planing with the center line of the plane over the edge formed by this side and the working face, still keeping the plane in a horizontal position. Examine the shaving cut when the plane was so held, and it will be found that the shaving is thicker on that side. A similar result will be noticed when the center line of the plane is over the other edge. This knowledge will be of use later when you wish to plane more off of one part of a narrow surface than another, to bring it square with a broad surface.

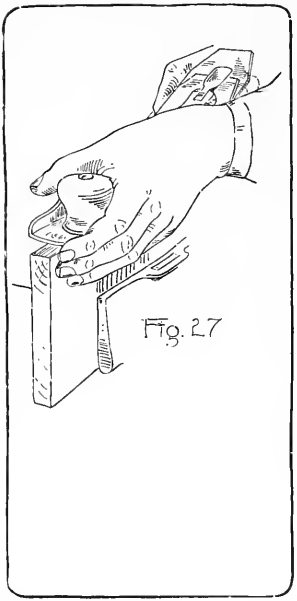


Fig. 27

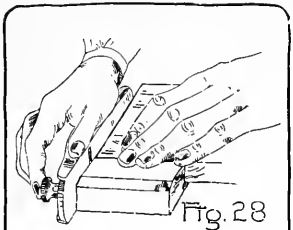


Fig. 28

(f) When this side appears smooth, mark two light slanting lines across it to designate it as the joint side.

(g) Plane the other narrow side in a similar manner until it appears smooth.

(h) In order that you may appreciate how thin a cut may be made with the plane, proceed as follows: Set the plane so as to cut as thin a shaving as can easily be cut the full width of this narrow side; set the gage at $\frac{1}{16}$" and with the gage-block against this narrow side gage the length of the working face; then count the number of full-length cuts of the plane on this narrow surface necessary to take off that $\frac{1}{16}$". It may be found that it has required as many as twenty-five cuts to do this, which would mean that each shaving was $\frac{1}{400}$" or less in thickness.

(i) Plane the other broad surface as in b and c until it appears smooth.

(j) Place the bench-hook on the bench with its smaller block clamped in the vise and its larger block on top. Place the piece on the bench-hook with the joint side against the block. Set the block-plane for a thin shaving and place it on its side on the bench, with the face of the plane toward the right side of the bench-hook (Fig. 28). Hold the block-plane in this position with the right hand, and move it from you, keeping it against the right side of the bench-hook. During this process the left hand holds the piece against the bench-book and at the same time exerts a slight pressure on the piece toward the right. The above operation is neither easy to describe nor easy for the begin-

ner to master. It requires a combination of forces of varying amounts: a comparatively strong one exerted by the right hand downward to keep the side of the block-plane against the bench, a lighter one exerted by the right hand toward the left to keep the lower edge of the plane in contact with the lower right hand edge of the bench-hook, a still lighter one exerted on the piece by the left hand toward the right to keep the end of the piece against the block plane, but not strong enough to push the plane away from the bench-hook.

Continue the above method of block-planing until the end appears smooth.

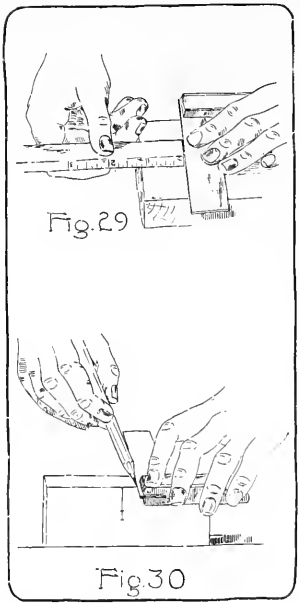
(k) Block-plane the other end as explained in j.

(l) Measure the width of one end of the piece and set the gage to one-half of this width. With the gage-block against the joint side, gage a line on the working face a little more than 1″ long, one end being at the end of the piece.

(m) With the rule and try-square used as in Fig. 29, measure $^3/_4$″ and 1″ from the end and draw knife lines about $^1/_4$″ long across the line gaged in l.

(n) Clamp the piece in the vice with the end up and, laying the rule on lengthwise of the end, locate a point $^1/_2$″ each side of the end of the gage line made in l. Draw through each of these points a pencil line across the end as in Fig. 30.

(o) Using the blade of the try-square as a straight-edge, draw lines on the working face from the ends of the lines just drawn to lthe point on the gage line 1″ from the end.



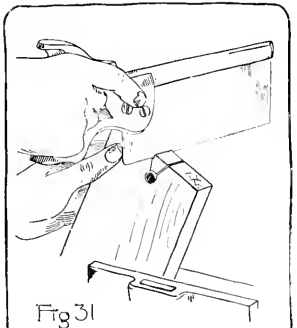
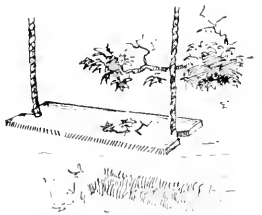


Fig 31

(p) Using the $\frac{1}{2}$″ bit, bore a hole as in Chapter II, n, at the point $\frac{3}{4}$″ from the end on the gage line.

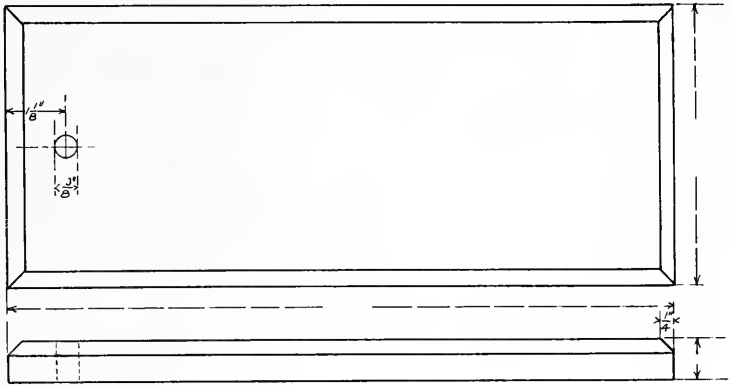
(q) Place the piece in the vise and saw with the back-saw (Fig. 31) so that the outer edge of the cut comes to the slanting lines, thus completing the notch in one end.

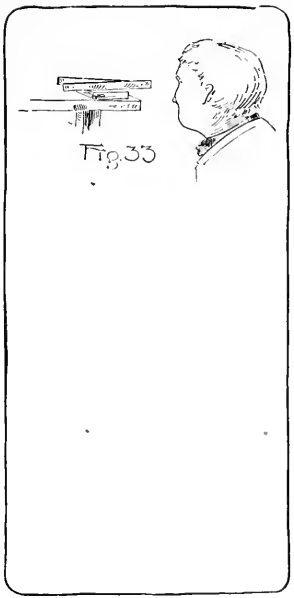
(r) Following the steps given in l to q, make a similar notch in the other end, thus completing the swing board. The board is intended for a rope $\frac{1}{2}$″ in diameter.



BREAD CUTTING BOARD

Fig. 32





CHAPTER IV.

PLANING.

In the last chapter, aside from getting acquainted with the plane and its possibilities, the effort was simply to get the piece of wood so that it appeared smooth. In this chapter the effort will be directed toward trueness, as well as smoothness; and what are known as the "rules for planing" will be followed.

Bread Cutting Board (Fig. 32). The material required is a piece of butternut 13″x5½″x⅞″. The tools to be used for the first time are the winding sticks.

(a) Select the surface desired for the working face, and using the straight edge,[1] test to see if this surface is so curved that the middle is higher than the edges. If it is, place the piece against the bench-stop, as in Fig. 1, and plane down the middle with the jack-plane until, when tested with the straight-edge, the middle is even with or slightly below the edges.

(b) Test the piece, when in this condition, with the winding-sticks to determine if there is a wind in the surface. To do this proceed as follows: Place the piece on the bench with the surface that is to be the working face on top and in such a position that you can look lengthwise of the piece (Fig. 33). Place one of the winding-sticks near the farther end extending at right angles to the length of the pieces, with the narrow edge on top, and with the bevel edge away from you. Place

[1]The blade of the try-square should be used as a straight-edge.

the other winding-stick on the nearer end in a similar position. Now, looking lengthwise of the piece, stoop down slowly so that the eye comes below the level of the top of the winding-sticks. As the eye is lowered the farther winding-stick will disappear behind the nearer one. If there is no wind in the piece both ends of the farther stick will disappear at the same time, but if there is a wind in the surface one end will disappear before the other. If a wind is shown, a little thought will determine which two diagonally opposite corners are high, and the wind in the surface may be removed by planing down one or both of these corners. This should not be done with short strokes just at the corners, but the area planed should extend about two-thirds of the length of the piece from the high corners toward the low corners. Care should be taken that nothing is planed off from the low corners.

(c) The planing and testing with both the straight-edge and winding-sticks should alternate until the surface is as true as you can make it; that is, there should be no wind in it, and when tested with the straight-edge (Fig. 34) both lengthwise and crosswise it should show a straight surface. Do not be suited with the good-enough kind of work, but have patience to work several hours if necessary to get a good, true working face. Set the plane very light for the last of the planing and study where the surface needs planing before touching the plane to it. Headwork is more essential than handwork in finishing this surface.

(d) When you have a true working face mark it with a light slanting line.

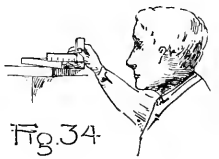
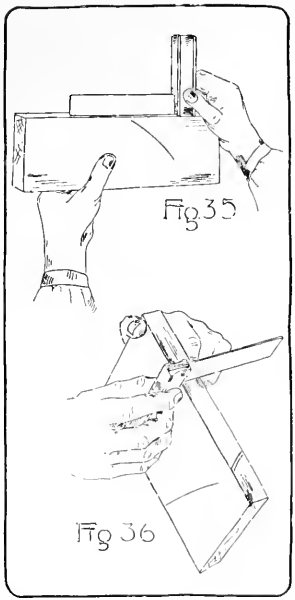


Fig. 34



(e) Place the piece in the vise with a narrow side up and plane this side (Fig. 27) until it is smooth and fulfills the following tests: When the straight edge rests lengthwise on this surface (Fig. 35) and is slid along its entire length, practically no light should be visible under the straight edge; when the straight edge rests on this narrow surface crosswise a similar condition should be shown; also when the beam of the try-square is held tight against the working face with the edge of the blade resting lightly on this narrow surface (Fig. 36) no light should appear between the blade and this narrow surface, as the square is slid along, testing all parts of the surface. This last test is to show that this narrow surface, which is to be the joint side, is at right angles to the working face.

(f) When the joint side is completed mark it with two light slanting lines.

(g) Measure the width of the piece at both ends and set the gage (Fig. 8) at an even eighth-inch mark; that is, about $\frac{1}{8}''$ less than the width of the narrower end.[1] With gage-block against the joint side, gage a line the entire length of the working face.

(h) Place the piece in the vice with the side opposite the joint side up, and plane exactly to the middle of the gage line. When within about $\frac{1}{32}''$ of the line, the tests applied to the joint side in e should

[1] It will be noticed that the length, width and thickness of the piece are omitted on the working drawing to allow some change of dimensions in planing this piece. When the rules for planing are referred to in later chapters the definite dimensions given are to be used in gaging.

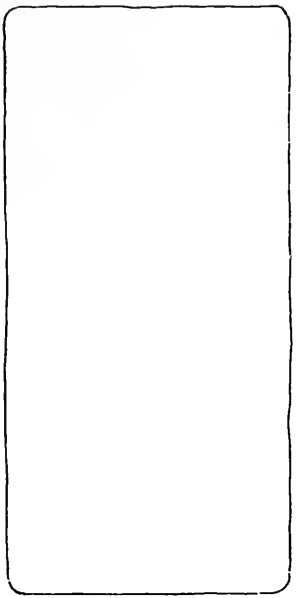
be applied to this narrow surface. The plane should then be set for a thinner shaving, and, if the tests have not shown the surface true, an effort should be made to correct the faults by the time the middle of the gage line is reached, but under no circumstances should any planing be done beyond the middle of the gage line, even if the surface is not as true as it should be.

(i) With the middle part of the rule, measure very accurately the width of the piece, and see if it is exactly the width selected in g when setting the gage. If it is not the exact width intended, an error is indicated, either in setting the gage, gaging, or planing, and it may be desirable to gage another line $\frac{1}{8}''$ less than the other, and try again to bring the piece to an exact width. This would not be possible when working to exact dimensions, but it is possible here and it is absolutely essential that one be able to plane to an exact width if he is to be a good workman.

(j) Set the gage to an even sixteenth mark, which is a little less than the thickness of the piece in its thinnest part, and with the gage-block against the working face, gage a line the entire length of the joint side and the opposite side.

(k) Place the piece on the bench with an end against the bench-stop and plane down to the middle of the gage line, testing with the straight-edge only and changing the set of the plane to a very light cut before reaching the line.

(l) It is desirable to test accurately the thickness, and if it has not been planed correctly, gage again and repeat the planing.



(m) Place the piece on the bench-hook, and block-plane one end as described in Chapter III, j, until it is smooth and is square with the working face and joint side, testing as follows: Hold the beam of the try-square tight against the joint side and slide it down until the blade touches the end lightly (Fig. 17). If the end is square with the joint side, practically no light will show between the blade and the end of the piece. In a similar manner, with the beam of the try-square against the working face, test to see if the end is square with the working face.

(n) Measure from this planed end, as in Fig. 14, an even length at least $\frac{1}{4}$″ less than the present length of the piece, and with the knife and try-square draw a line square around the piece through the point so determined.

(o) Saw a little outside of this line; then block-plane to the knife line. Test to see if the piece has been brought accurately to length.

(p) With the beam of the try-square against the joint side, measure so that the edge of the blade is $1\frac{1}{8}$″ from one of the ends of the piece (Fig. 29) and draw a knife line about $\frac{1}{4}$″ long so that it will cross the middle of the piece, which point may be determined by the graduations on the blade of the try-square.

(q) Set gage at one-half the width of the piece and gage a line about $\frac{1}{4}$″ long crossing the knife line. With the $\frac{3}{8}$″ auger-bit bore a hole where these two lines intersect.

(r) Gage a light pencil line on and entirely around the working face, $\frac{1}{4}$″ from its outer edges, in the following manner: Clamp

the piece in the vise, with the working face up, so that at least one-half of the length of the piece extends beyond and above the vise (Fig. 37). Slide the gage-block to a point nearly $\frac{1}{4}$″ from the end of the beam which has no metal point. Hold the back of the gage-block against the side of the piece with the left hand, and place the right hand against the side of the gage-block that is touching the piece, the little finger and the one next to it resting against the gage-block, thus supporting the hand (Fig. 37), and the thumb and first two fingers holding the pencil so that its point is in the notch[1] in the end of the gage-stick. Now, moving the gage along, with both hands supported on it, a pencil line is made parallel to the edge of the working face. Measure the distance this line is from the edge and if it is not $\frac{1}{4}$″ from the edge, change the position of the gage-block until the line will be $\frac{1}{4}$″ from the edge. In the manner described, gage a line on the working face across the end that is not in the vise and along each side as far as possible. Change the piece in the vise so that you can gage on the other end and complete the line around the working face.

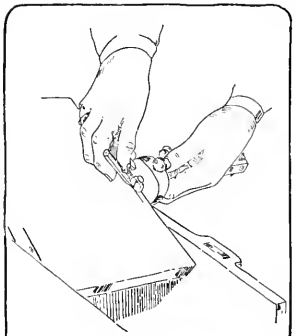


Fig. 37

(s) Clamp the piece in the vise so that the joint side is on top; then hold the gage-block set as in r against the working face and mark a pencil line along the entire length of the joint side. In a similar manner gage a pencil line across each end and along the side opposite the joint side.

[1] If there is no notch in the back end of the gage-stick, one may readily be made with the knife.

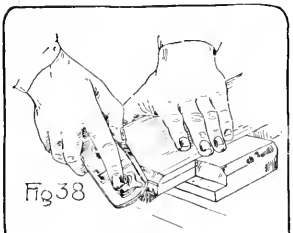


Fig 38

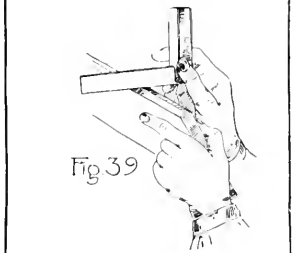


Fig 39

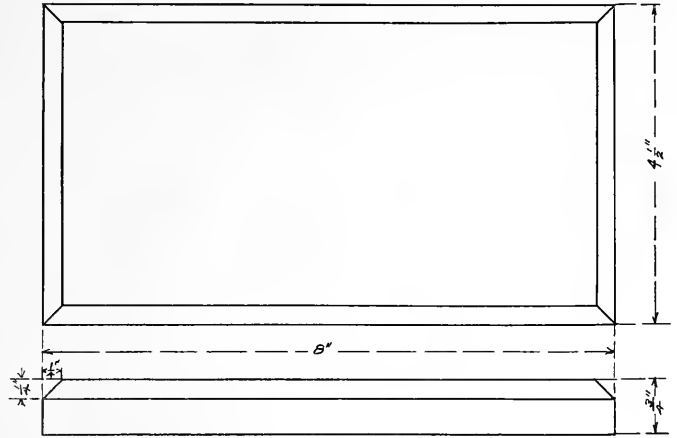
(t) Holding the piece on the bench-hook as for sawing, block-plane a bevel, or chamfer, down to the pencil line (Fig. 38). Hold the block-plane so that its center line points diagonally across the edge to be planed off, and the sharpened edge of the plane-iron is parallel to an imaginary surface containing the two pencil lines, then move the plane in the direction of the edge to be planed off. Before reaching either pencil line, test with the straight-edge, as in Fig. 39, to see that the chamfer is straight across, and notice if the edges of the surface just planed are equal distances from the pencil lines. Try to have a true surface when the two pencil lines are reached, but do not go beyond the lines to correct it. Plane a chamfer on the other end in the same way.

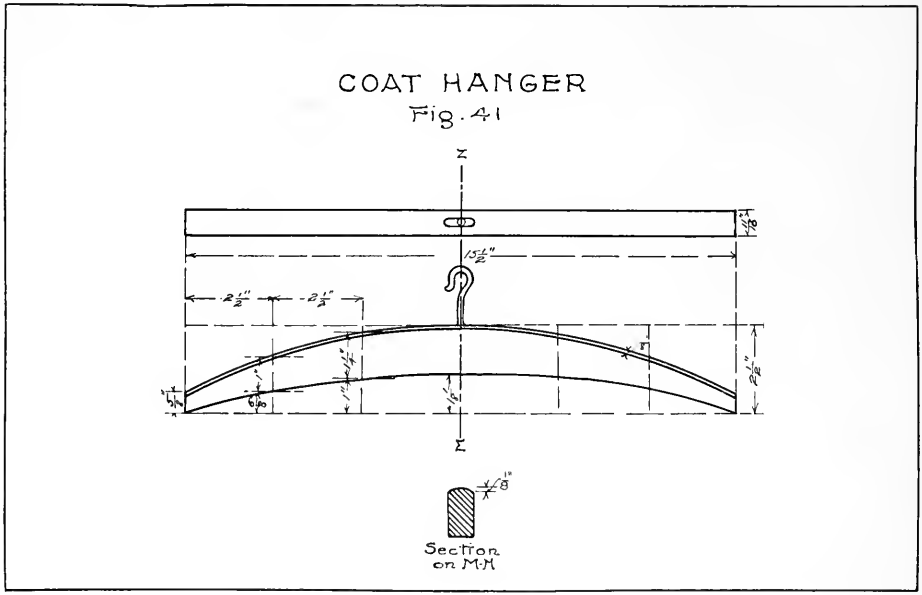
(u) Clamp the piece in the vise with the joint side up and the working face toward the bench. Hold the jack-plane as in Fig. 27, but tip it toward the bench, so that the sharpened edge of the plane-iron is parallel to an imaginary surface containing the two pencil lines; now plane off the chamfer to the two pencil lines, testing as explained in t. In the same manner, plane the chamfer on the other edge. This completes the bread-cutting board.

Pieces similar in form to the bread-cutting board are in quite common use. One made of tulip wood following the working drawing in Fig. 40 makes a very convenient board on which to hold work while chiseling, to protect the bench from injury. A board made of hard wood, such as birch or maple, and of somewhat different dimensions, makes a serviceable board on which to cut or pound meat.

CHISELING BOARD

Fig 40




COAT HANGER
Fig. 41
Z
Σ
Section on M-M

CHAPTER V.

Curve Sawing and Spokeshaving.

In this chapter the method followed in simple modeling, as employed in producing a piece of curved outline, is explained.

Coat Hanger (Fig. 41.) The material required is a piece of redwood $16''x2\frac{3}{4}''x1\frac{3}{16}''$ and a No. 10 screw-hook. The new tools to be used are the turning saw, spokeshave and twist-bit. The spokeshave is practically a very short plane with handles on the sides, by means of which it may be pulled toward or pushed away from you. The thickness of the shaving may be regulated by the adjusting screws. The spokeshave is used to form and smooth curved surfaces.

(a) The working face and joint side should be planed as in Chapter IV, a to f.

(b) Do not gage or plane the piece to width but smooth the side opposite the joint side with a few strokes of the plane.

(c) Gage the thickness (1)[1] of the piece from the working face on the joint side and the side opposite.

(d) Plane to thickness as in Chapter IV, k.

(e) With the block-plane bring the piece to the exact length (2) in a manner similar to that described in Chapter IV, m to o.

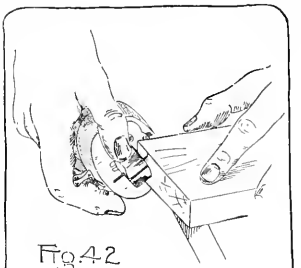


Fig. 42

[1]From this point on, the student should try to determine the dimensions from the working drawing, but if he is unable to do so or wishes to check his results, the dimensions which are denoted in the text by numbers may be found in the appendix at the end of the book.

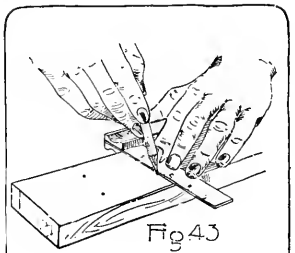


Fig 43

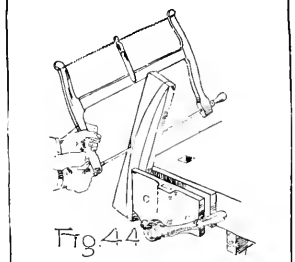


Fig 44

(f) Set the gage to $\frac{5}{8}$", and with the gage-block against the joint side, gage a line across each end as in Fig. 42.

(g) Place the try-square on the piece with the blade on the working face and the beam against the joint side. Now hold the try-square with the left hand (Fig. 29) and move it to the distance (3) from the end necessary for locating the first two points for the curves; then using the graduations on the blade of the try-square make marks (Fig. 43) with a sharp pencil at the correct distances (4 and 5) from the joint side. By a similar method locate (6) the next pair of marks (7 and 8), also locate (9) the middle points (10, 3). The points on the other end are located in the same way.

(h) With a pencil draw a light line through the five points farthest from the joint side, extending it to the ends of the gage lines that were made on the ends of the piece, and in a similar manner draw a line through the five points nearest the joint side extending it to the corners of the working face next to the joint side. By making the lines light at first, corrections may easily be made in them until smooth curves are formed.

(i) Clamp a practice piece in the vise and try sawing irregular curves with the turning saw, holding the saw as in Fig. 44; continue the practice work until able to control the saw. It will be noticed that by turning the handles the blade of the saw may be turned to different positions with reference to the frame, thus making it possible to avoid obstructions that are in the way of the frame, but be sure that the saw blade is not twisted.

(j) Now clamp the piece for the coat hanger in the vise as in Fig. 44 and saw about $\frac{1}{8}$" outside of the curve for the top of the coat hanger. Start the saw near the middle and saw to the end, taking notice that the blade is kept perpendicular to the working face. Change the piece in the vise so that the corner of the piece diagonally opposite will be clamped in a similar position in the vise, and saw from the middle to the other end of the piece.

(k) Now clamp the piece in the vise as in Fig. 45 and saw about $\frac{1}{8}$" outside of the lower curve. Saw from the end to about the middle of the piece. Change the position of the piece in the vise and saw from the other end until the saw cut made from the opposite end is reached.

(l) Using one of the scrap pieces sawed off in j as a prop, clamp it and the coat hanger in the vise as shown in Fig. 46. Now with the spokeshave (Fig. 47) cut as in Fig. 46 from the middle to the end on the convex side until the pencil line is reached. A test should be made with the try-square before the line is reached to determine whether this surface is square with the working face and if it is not an effort should be made to correct the defect by the time the line is reached, but do not go beyond the line to do it. In a similar manner smooth down the remainder of the curve by cutting from the middle toward the other end.

(m) With the beam of the try-square against the working face and the blade extending across the surface just finished, draw a knife line square across this surface even with the middle point marked in g.

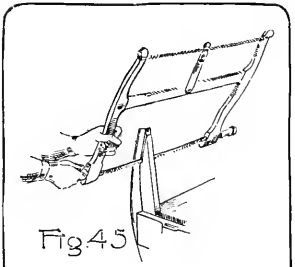


Fig. 45

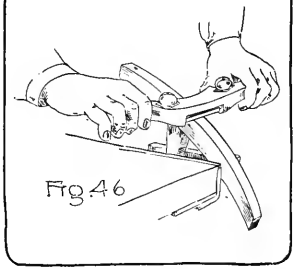
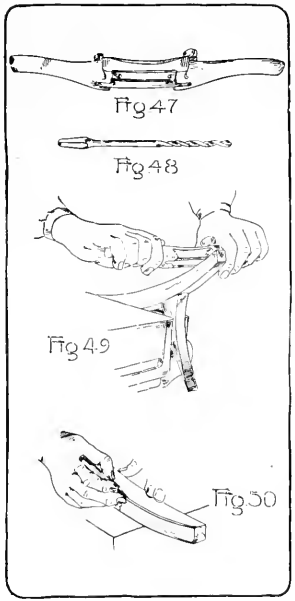


Fig. 46



Set the gage at $\frac{11}{32}$″ and with the gage-block against the working face gage a short line crossing the knife line. Where these lines cross, bore a hole for the hook 1″ deep, using the $\frac{4}{32}$″ twist-bit (Fig. 48). To do this, fasten the bit in the brace and measure the length of the bit exposed outside of the brace. Then bore the hole until 1″ less than that amount is exposed between the brace and the wood. Use care that the hole is bored straight.

(n) Clamp the piece and prop in the vise as in Fig. 49, and with the spokeshave, cut from the end toward the middle on the lower or concave side until the line is reached, testing with the try-square as in l. Reverse the piece in the vise and smooth the remainder of the concave side in a similar manner. Great care must be used when working near the ends on the concave side as the curve should be concave entirely to the end, and at the same time nothing should be cut from the edge that was orignally formed by the joint side and end.

(o) Hold the pencil as in Fig. 50 and try gaging a pencil line parallel to and near the edge of a practice piece, using only the hand and pencil. When able to do this well gage a light line in a similar manner $\frac{1}{8}$″ from the convex edge on both the working face and the surface opposite. Also gage two lines on the convex surface, one of them $\frac{3}{16}$″ from the working face and the other $\frac{3}{16}$″ from the opposite surface.

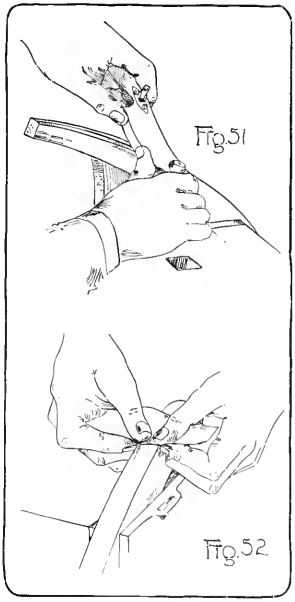
(p) Again clamp the piece in the vise, and with the spokeshave, cut two bevels, or chamfers, on the convex side down to these pencil

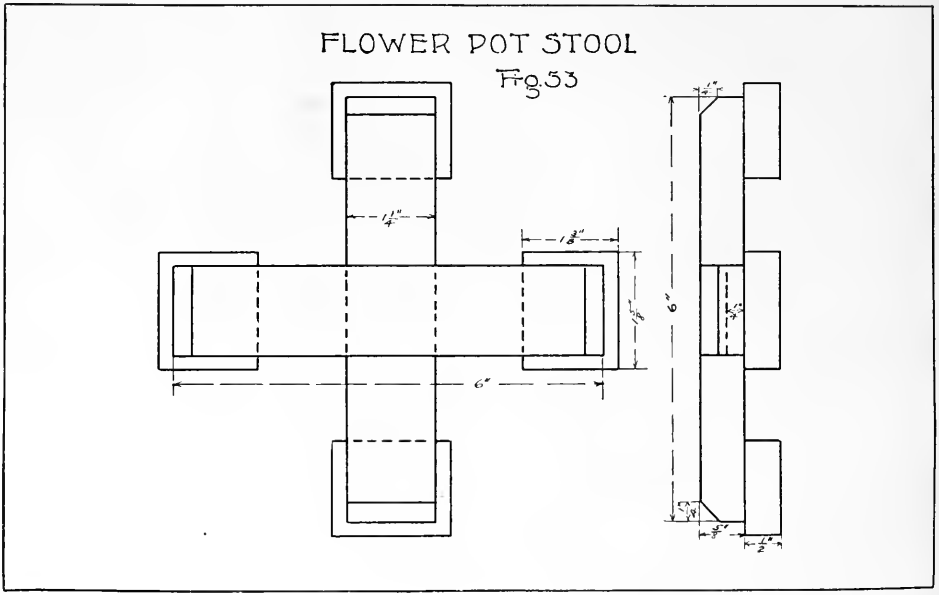
lines (Fig. 51.) Test with the straight-edge as in Fig. 39 to make sure that each of these bevels is straight across and not left high in the middle. This will form three surfaces on the convex side. One is a part of the orignal surface and the other two are the bevels just cut.

(q) The two parellel edges that now run lengthwise of the convex side should be cut off with the spokeshave, forming two narrow surfaces in their places. Each additional cut widens these surfaces but the cutting should not continue after the width of each of the new surfaces is the same as the part that remains of the three original surfaces. This should make five equal-width surfaces and four parallel edges.

(r) If this work of modeling, as it is called, has been done with care it will be possible to continue the process still further by forming four new surfaces in place of the four edges, making nine equal-width surfaces, but do not touch the spokeshave to the work unless sure that an edge can be replaced by a surface narrower than those already on the piece.

(s) With a piece of No. 1_2 sandpaper about 3″x4″ rub this surface as shown in Fig. 52 until the the surface is as smooth as the planed surfaces. Screw the hook into the hole made in m and the coat hanger is ready for use.




FLOWER POT STOOL
Fig. 53
1¼"
1⅜"
1⅜"
6"
6"
¼"
¾"
½"

CHAPTER VI.

Chiseling and Joining.

The work of this chapter is given as a means of acquiring a knowledge of the fundamental principles of laying out and cutting a joint, and it will also emphasize the accuracy necessary in this class of work.

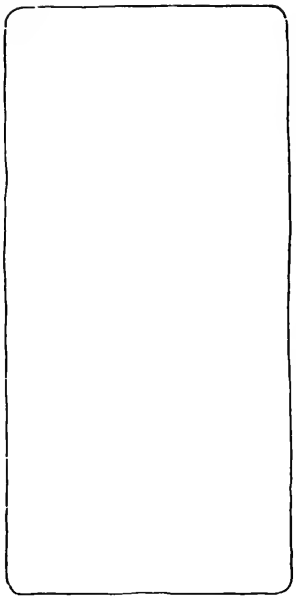
Flower Pot Stool. (Fig. 53). The material required will be a piece of white pine 13″x1½″x¾″ for the cross-pieces, and one 9″x 1⅞″x⅝″ for the feet, also sixteen 1″ brads. The new tools to be used are the chisel, hammer and nailset.

(a) Plane the piece for the two cross-pieces of the flower-pot stool to the required width (11) and thickness (4) by a method similar to that explained in Chapter IV, a to k, but, of course, set the gage to the width and thickness given in the working drawing; no second trials will be possible in planing this piece. Mark the working face and joint side in two places, as later it is to be cut into two pieces.

(b) Block-plane both ends of the piece as in Chapter IV, m.

(c) From each of these block-planed ends measure the length (12) of each of the pieces which are to form the cross, and draw knife lines square around the piece at the two points so determined. Do not cut this into two pieces until directed to do so in s.

(d) Consulting the working drawing determine the distance (13) from the end of one of the cross-pieces to the nearer edge of the



joint. From one end of the piece of wood measure (as in Fig. 29) this distance on the working face, and as in Fig. 14 measure on from this point the exact width (11) of the joint, which is equal to the width of the piece of wood.

(e) With the beam of the try-square against the joint side, draw knife lines across the working face through these two points, and with the beam of the try-square against the working face extend each end of these lines down $\frac{1}{4}$″ on the joint side and the opposite side.

(f) On the surface opposite the working face measure from the other end of the piece the distance (13) to the nearer edge of the joint and then measure on from this point the exact width (11) of the joint.

(g) With the beam of the try-square against the joint side, draw knife lines across this surface through these two points, and with the beam of the try-square against the working face extend each end of these lines to within $\frac{1}{4}$″ of the working face on the joint side and the opposite side.

(h) Determine the distance (14) that the horizontal joining surfaces are to be above the bottom of the cross-pieces, and set the gage equal to this distance. With the gage-block against the working face, gage a line between each of the two pairs of knife lines on the joint side and the side opposite.

(i) Place the piece on the bench-hook with the working face up and with the end of the piece having the knife lines on that surface to the right. Saw with the back-saw so that the right side of the

saw cut comes exactly to the knife line that is nearer to the end. Saw until the points of the saw teeth just come, at the same time, to the gage line on the joint side and the side opposite. Great care should be used in doing this sawing.

(j) In a similar manner make another saw cut so that the left side of the cut comes exactly to the other knife line, and saw down to the gage lines.

(k) Turn the piece over so that the surface opposite the working face is on top, and with the knife lines for the joint near the right end; then saw to the gage lines as in i and j.

(l) Clamp the piece in the vise in a slanting position with the working face on top and so that the part between the two saw cuts which is to be chiseled out is a little above the bench and to the right of the vise (Fig. 54). Hold the handle of the chisel in the right hand and the blade, with its bevel on top, between the thumb and fingers of the left hand, which should rest against the front side of the piece. Push the chisel in a direction at right angles to the length of the piece, and with cutting edge slightly inclined to the surface of the piece, so that the left end of the cutting edge moves in a line near the left saw cut and the right end is raised to such a height that it is just above the surface of the wood. In this manner a cut is made about half way across the piece. The left hand being held stationary against the piece, the pressing together of the thumb and fingers may be used to keep the chisel from cutting too far.

(m) The second cut should be made in a similar manner about

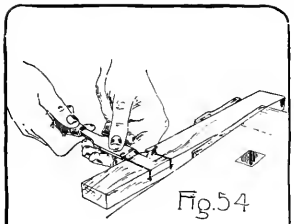


Fig. 54

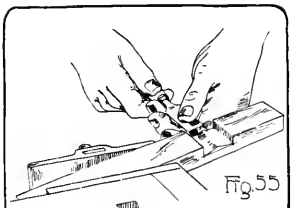


Fig. 55

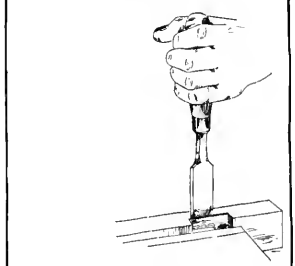


Fig. 56

half way across the piece, but the right end of the cutting edge of the chisel should be lower than the left and should cut near to the right saw cut. The left end should be just above the surface of the wood.

(n) Alternating cuts similar to those in l and m should be made until the lower edge of the chisel cuts about half way down to the gage line.

(o) Reverse the piece in the vise so that the part just chiseled is on top and a little to the left of the vise. This brings toward the worker the part between the two lines that has not been chiseled out. Then alternate the cuts as described in l and m until the lower edge of the chisel cuts to the gage line.

(p) Change the position in the vise to that used in l, and continue the alternating cuts until the lower edge of the chisel cuts to the gage line. If the chiseling has been well done a low distinct ridge of wood will extend across the piece midway between the two sawed surfaces.

(q) With the piece clamped as in o, pare off the middle of this ridge holding the chisel as above, except that the cutting edge is parallel to the gage line (Fig. 55). Pare half way across and to within about $\frac{1}{32}$″ of the gage line; then reverse the piece and do the same from the other side.

(r) Clamp the piece in the vise with the joint side up and the partly made groove near the middle of the vise. With the left hand, hold the chisel in a vertical position with the sharp edge in the gage line and the bevel toward the groove (Fig. 56). Use the palm of the

right hand as a mallet and strike the handle of the chisel a light blow. This will make a good, right-angled edge exactly where it should be. Turn the piece over in the vise and do the same on the side opposite the joint side. Clamp the piece and hold the chisel as in q; then pare out the bottom of the groove until it is a true surface, testing it with the straight edge (Fig. 57). Great care must be used that the chisel does not slip and cut the sharp right-angled edges. This completes the cutting of the first groove. The second should be made in the same way.

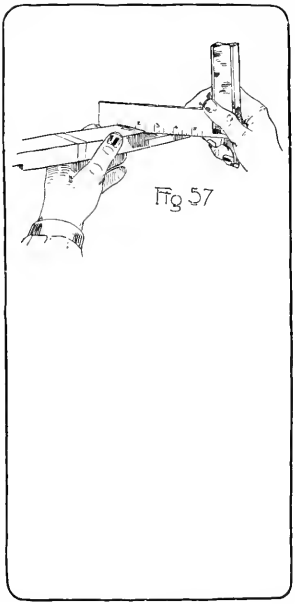


Fig 57

(s) After the second groove is completed the piece should be sawed into two parts. Saw each part about $\frac{1}{32}$" longer than the length indicated by the knife lines, and block-plane them to their correct length.

(t) Determine from the working drawing the distance (14) the pencil lines for the chamfer should be from the edge formed by the ends and the surface opposite the working face, then lay out the chamfer on the ends of the two pieces as explained in Chapter IV, r and s, and block-plane the chamfers as in Chapter IV, t. In this block-planing, care should be used that the center line of the plane is held at a considerable angle with the edge being planed or the corners will be splintered. When the chamfers are completed the two pieces may be put together. If a good joint has been made, they may be forced together with the hands and will not fall apart of their own weight.

(u) Next take the piece for the feet, and by a method similar

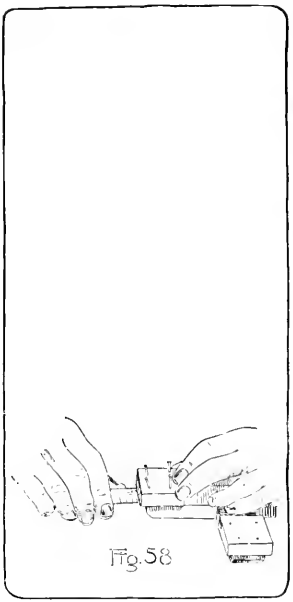


Fig. 58

to that explained in Chapter IV, a to k, plane to width (5)[1] and thickness (15), marking working face and joint side in at least four places; then block-plane one end. From this block-planed end, measure the length (16) of one of the feet of the flower-pot stool; then square around the piece at this point with the knife and try-square. Saw a little longer than the length indicated; then block-plane to length. Again, block-plane the end of the piece that is left, and continue as above, making each of the other feet as explained.

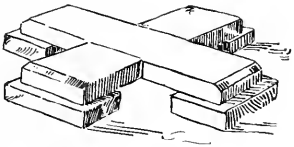
(v) One of these feet should be nailed under each end of the cross-pieces, and should have its working face against the cross-piece. Four 1″ brads should be used. The two outer ones should be a little closer together than the two inner ones, and should be slightly inclined so that the points will not be liable to prick through the chamfer. Drive the nails into one of the feet until the points just prick through; then place it on the cross-piece, changing its position until there is a uniform margin at the end and on each side of the cross-piece. This may be determined by measuring, as in Fig. 58.

(w) The nails should not be driven entirely in with the hammer, as it will mar the surface of the wood, but by using the nailset as in Fig. 59, they may be driven in until their heads are slightly below

[1]The length of a piece of wood is usally measured in the direction of the grain, even if that is shorter than the width, which is measured crosswise of the grain. The grain of wood in the feet is to extend in the same direction as that in the piece to which it is attached.

the surface. In using the nailset it should be held in the left hand with one finger resting on the piece of wood and against the side of the nailset as in Fig. 59. This serves as a support to hold the point of the set on the head of the nail while the top of the nailset is struck a light blow with the hammer. This completes the flower-pot stool.

This piece as completed might be used as a base for a small Christmas tree. In this case it would be well to bore a hole of the required size for the lower end of the tree through the middle of the upper part of the joint and a smaller hole through the lower part of the joint. Through this smaller hole a screw could be entered from below into the body of the tree. A piece made in the same manner but to larger dimensions would make a good base for a large tree.



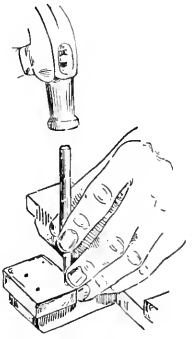
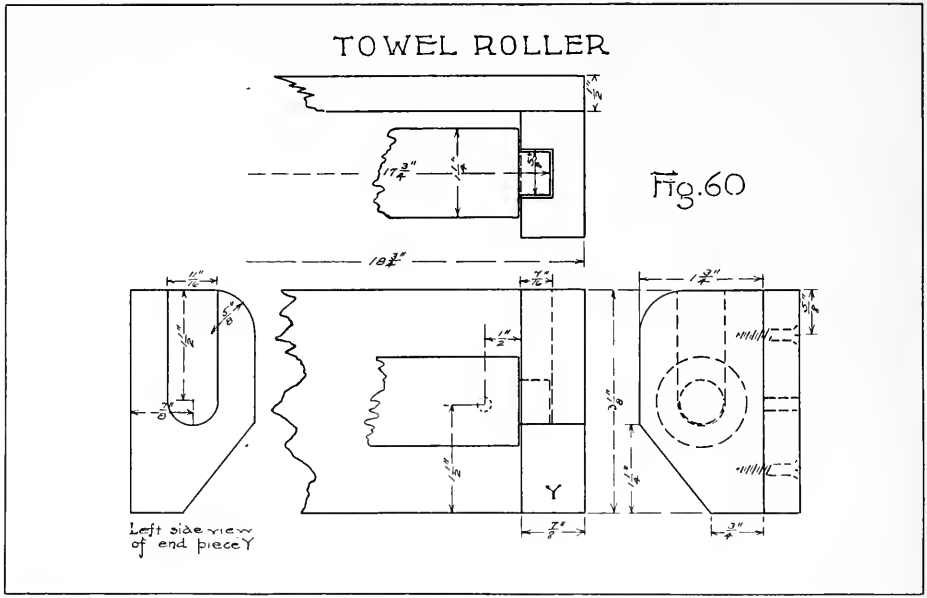


Fig. 59


TOWEL ROLLER
Fig. 60
Left side view of end piece Y
Y

CHAPTER VII.

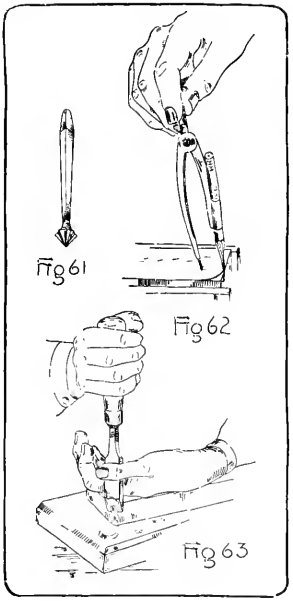
Chiseling and Planing.

In this chapter, work of a different kind is done with the chisel and, in addition, good experience is gained in planing a cylinder and in fastening pieces together.

Towel Roller (Fig. 60). The material required is three pieces of cypress—one for the back $19\frac{1}{4}''$x$3\frac{3}{8}''$x$\frac{5}{8}''$, one for the ends 7″x2″x1″, one for the roller $18\frac{3}{4}''$x$1\frac{1}{2}''$x$1\frac{1}{2}''$—four 1″ No. 10 flat-head, bright screws, and two $1\frac{1}{2}''$ No. 10 flat-head bright, screws. The tools to be used for the first time are the compass, countersink and screw-driver.

(a) Plane the piece for the back by the rules for planing, Chapter IV, a to o, to dimensions (17, 18, 15).

(b) To locate the holes for the screws, place the try-square on the piece, with the beam against the joint side and the blade on the side opposite the working face. Using the rule as in Fig. 29, move the try-square to such a position that its edge shall be $\frac{5}{16}''$ from the end and draw two short knife lines about $\frac{5}{8}''$ from each side. Set the gage to $\frac{5}{8}''$ and gage from the joint side and from the side opposite, making short gage lines crossing the short knife lines. In the same way make two knife and gage lines for the two holes at the other end of the piece. In a similar manner locate the holes for fastening the towel roller to the wall, $1\frac{3}{8}''$ from each end and $1\frac{1}{2}''$ from the joint side.



(c) Place the $\frac{3}{16}$" auger-bit in the brace and bore six holes through the piece at the points indicated by the cross lines.

(d) Place the countersink (Fig. 61) in the brace and countersink the two holes at each end on the side opposite the working face and the other two on the working face until, when one of the screws is placed in a hole, the top of the head is slightly below the surface.

(e) Plane the piece for the ends, by the rules for planing, to width (19) and thickness (20), and block-plane each end square as in Chapter IV, m. Measure from each of these ends the length of the end piece (18) and make a knife line square around the piece at each of these points.

(f) Using very light lines, locate on the side opposite the working face two points as centers of the quarter circles, each point to be $\frac{5}{8}$" from the side opposite the joint side and $\frac{5}{8}$" from each end, using the same method that was used in b. Set the pencil compass to $\frac{5}{8}$" and draw quarter-circles using as centers the points where the knife and gage lines intersect (Fig. 62).

(g) Place the piece flat on a chiseling board[1] with the working face down and the corner to be rounded, away from you. Hold the piece in this position by resting the back of the left hand on the piece; then take the larger chisel in the right hand so that the little finger is at the end of the handle nearer the blade (Fig. 63). Take a thin cut off the corner by pushing the chisel down in a vertical direction,

[1] If no chiseling board has been provided, the practice piece used in Chapter II will do very well for a substitute.

the blade being held between the thumb and first finger of the left hand. By pinching the thumb and finger together they will aid in controlling the cuts of the chisel. Continue this chiseling until the surface is tangent to the quarter-circle; that is, until it touches it in one point. Before this chiseling is completed, the surface should be tested to see if it is coming square with the working face. It is also desirable that this surface should make equal angles with the end of the piece and the side opposite the joint side. Two parallel vertical edges are formed by this chiseling. These edges should be chiseled off in the same manner as above until two surfaces are formed in place of the two edges; these surfaces should be tangent to the quarter-circle. If the work has been carefully done there will be three equal-width surfaces and four parallel vertical edges. In a similar manner continue the chiseling until four very narrow surfaces have been made tangent to the quarter circle in place of the four edges. There will then be seven equal-width surfaces. This will probably be as far as this process can be continued, but it should be carried further if an edge can be replaced by a suface narrower than those just made. Clamp the piece in the vise (Fig. 64), and with a piece of No. $\frac{1}{2}$ sandpaper wrapped around a small block, rub the rounded surfaces until they are smooth and the grain of the wood has a clear appearance.

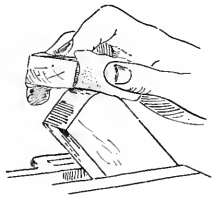


Fig. 64

(h) By the same method as used in b, locate on the working face of this piece two points each $1\frac{1}{2}''$ from each end and $\frac{7}{8}''$ from the joint side.

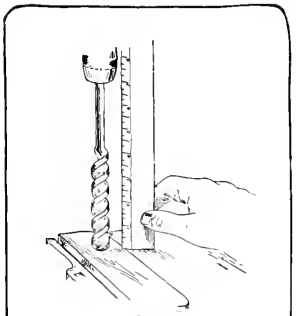


Fig. 65

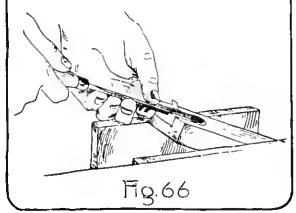


Fig. 66

(i) At the points located in h, bore with the $\frac{1}{16}$" auger-bit until the lips (Fig. 19) of the bit are just ready to raise a chip. Then with the rule measure the distance from the surface of the piece to the chuck of the brace (Fig. 65). Now bore until the distance from the surface to the chuck is $\frac{7}{16}$" less than when first measured. This indicates that the bit has bored that distance.

(j) Set the gage to the distance that the nearer side of the hole in the part that is to be the right end piece is from the joint side, and gage from the hole to the nearer end of the piece. Continue this gage line about half-way across the end, keeping the gage-block against the joint side. Now change the set of the gage to the distance the farther side of the hole is from the joint side, and gage as before to the end of the piece and about half-way across the end. Set the gage to the same distance (21) as the depth of the hole and with the gage-block against the working face, gage a line between the two lines that were gaged half-way across the end.

(k) Clamp the piece in the vise with the working face up and the end on which the gage lines were made at the right and a little above the top of the bench. With the $\frac{5}{16}$" chisel remove the wood bounded by these lines between the hole and the end of the piece. First, cut as in Fig. 66, making a groove a little wider than the chisel, and nearly down to the gage line. Turn the chisel on edge and pare out nearly to the other gage lines. Now using the chisel as in Chapter VI, r, form good right-angled edges where the gage lines are, and continue the paring until the groove is of a uniform width and depth.

(l) Now bring the two end pieces to length by sawing a little beyond the knife lines that were drawn around the piece in e, and then block-plane each piece to the knife line. Using the pencil and try-square as in Fig. 30, draw pencil lines across each of these block-planed ends parallel to and as far from the joint side as the width (22) of the bottom of each end piece. In a similar manner draw pencil lines across the sides opposite the joint sides parallel to and as far (11) from the ends block-planed last as the obtuse-angled corner is to be above the bottom of the end piece. With the straight-edge and knife, draw lines on the working face and the surface opposite, connecting the ends of these pencil lines. Clamp the piece in the left end of the vise so that these knife lines are vertical, and saw a little outside of the line. Next, clamp the piece in the vise with this sawed surface in a horizontal position, with the wider end of the piece to the right and then block-plane to the lines.

(m) Now clamp one of these end pieces in the vise with the joint side up, and place the back piece on it with its working face down, its end even with the surface of the end piece opposite the working face, and its sides even with the ends of the end piece. Hold it in this position; then place the two screws in the holes in the back and strike them lightly with the hammer (Fig. 67). Now with the $\frac{1}{32}$" twist-bit, bore a hole $\frac{1}{2}$" deep at each of the points located by the screw points. In a similar manner the two holes for the screws may be located and bored in the other end piece. The back may now be screwed to the two end pieces by using the screwdriver (Fig. 68).

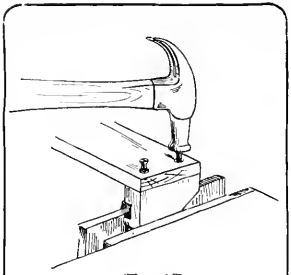


Fig 67

Fig 68

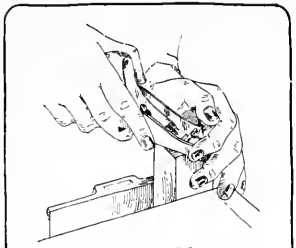


Fig. 69

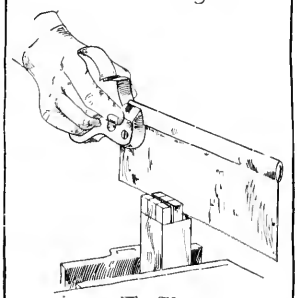


Fig. 70

(n) Plane the piece for the roller by the rules for planing to length (23), width (11), and thickness (11). In block-planing the ends of such a piece as this it is not convenient to use the bench-hook but the piece should be clamped in the vise (Fig. 69). and planed from each corner toward and about two-thirds of the way to the diagonally opposite corner, testing with the try-square to determine when it is square with the working face and joint side.

(o) Draw knife lines square around the piece $\frac{5}{16}$" from each end; then set the gage to $\frac{5}{16}$", and with the gage block against the working face, gage from these knife lines to the ends of the piece on the joint side and the side opposite and across each end. Also, with the gage-block against the joint side, gage from these knife lines to the ends of the piece on the working face and the surface opposite and across each end. Now change the set of the gage to $\frac{3}{16}$" and gage again in the same maner as above.

(p) Clamp the piece in the vise in a vertical position with the working face to the front, then with the back-saw start a cut in the end of the piece, so that the left edge of the saw teeth will just cut to the center of the right hand gage line (Fig. 70). Use great care in doing this sawing and continue it until about $\frac{1}{32}$" from the knife line. In a similar manner saw so that the right side of the saw teeth cut to the center of the left hand gage line. Turn the piece in the vise so that the joint side is toward the front and make two more saw cuts as above. Now place the piece on the bench-hook, and holding it as in Fig. 16, saw off the pieces outside of these saw cuts, sawing so that the left side

of the saw teeth cut exactly to the knife line. This will form a square prism projecting from the end of the piece. In the same manner form a similar prism on the other end of the piece.

(q) Draw two light knife lines across any part of the working face exactly $1\frac{1}{4}''$ apart; these lines with the parts of the edges between them will form a square. Measure accurately the length of the diagonal of this square and set the gage to exactly one-half the length of this diagonal. With the gage-block against the working face gage a light line the entire length of the joint side and the side opposite. In a similar manner place the gage-block against each of the other three surfaces and gage two lines. This will make two gage lines on each surface.

(r) Clamp the piece in the vise with one of its edges upward and above the top of the vise. Plane off this edge with the jack-plane, forming a chamfer (Fig. 71). Continue planing until just down to the gage lines made in q, testing the chamfer with a straight-edge (Fig. 39). In a similar manner plane a chamfer in place of each of the other three edges. The piece for the roller should now have eight equal-width surfaces. Mark a pencil line across each of these eight surfaces. The center line of each of these will be on the finished roller.

(s) Clamp the piece in the vise again with one of its eight edges upward and above the top of the vise; then with the jack-plane take off a few cuts forming a narrow surface in place of the edge. Endeavor to have this new surface make equal angles with the two surfaces adjacent to it. In a similar manner form a new surface in place

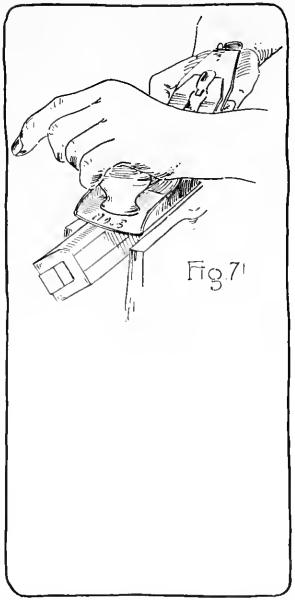
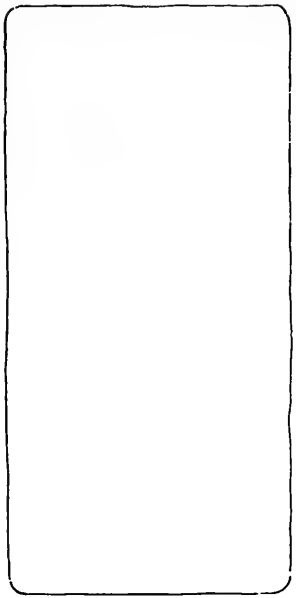


Fig. 71



of the seven other edges. The roller now has sixteen surfaces and unless too heavy cuts have been taken the eight new surfaces are narrower than the eight original ones which have the pencil marks on them. A little at a time should be planed from each of the newly made surfaces until all sixteen surfaces are of the same width. Make a pencil line on the eight new surfaces.

(t) Following the same method as in s, with the plane set light, the sixteen edges may be replaced by sixteen surfaces of such a width that there will be thirty-two equal-width surfaces, and it is possible that some may be able to continue the process until sixty-four equal-width surfaces are formed, but do not touch the plane to the roller unless sure that an edge can be replaced by a surface narrower than those already on the piece.

(u) By a method similar to that used in planing the roller the square prisms on the ends of the roller may be made round, using the chisel instead of the plane. In doing this work make sure that each step is well completed before starting the next.

(v) The surface of the roller may now be smoothed by wrapping a piece of sandpaper around the roller and rubbing it lengthwise until the surface is smooth and the grain of the wood is brought out clear. The roller may now be placed in position by inserting one end in the hole in the left end piece and sliding the other end down the slot in the right end piece. Two $1\frac{1}{2}''$ No. 10 flat-head screws should be used to fasten the completed piece to the wall.

CHAPTER VIII.

Furniture Making—Keyed Construction.

The purpose of this chapter is to make clear the manner in which the principles already learned may be applied in working out simple problems in furniture construction. In this class of work it is necessary to use special care in laying out pieces that are to be in different parts of the completed piece of furniture but are to be of equal length. It will therefore be noticed that, where possible, pieces which are to be of the same dimensions are laid out together. Thought should also be given to determining where the working faces and joint sides of the various pieces are to be placed. All gaging for joints should be done from these surfaces, and all gaging with the same setting of the gage should be done at one time.

Taboret (Fig. 74.) The material required is a piece of chestnut 4′ 2″ long, $13\frac{1}{2}$″ wide, and $\frac{7}{8}$″ thick, if supplied with saws to cut it up; or the lumber may be purchased cut to the following dimensions: four pieces 18″x$2\frac{3}{4}$″x$\frac{7}{8}$″ for the legs, two pieces $14\frac{1}{2}$″x$2\frac{3}{4}$″x$\frac{7}{8}$″ for the lower braces, two piece $14\frac{1}{2}$″x$2\frac{1}{2}$″x$\frac{7}{8}$″ for the upper braces, one piece 12″x1″x$\frac{5}{8}$″ for the keys, and two pieces 16″x8″x$\frac{7}{8}$″ for the top. There will also be needed four $1\frac{1}{2}$″ No. 10 round-head blue screws for fastening on the top, a small bottle of liquid glue, a 2-oz. bottle of strong ammonia, and about 1 oz. of four parts boiled oil and one part hard oil finish. The following is required for the clamps: two pieces of cheap pine "two by four", each two feet long, for the

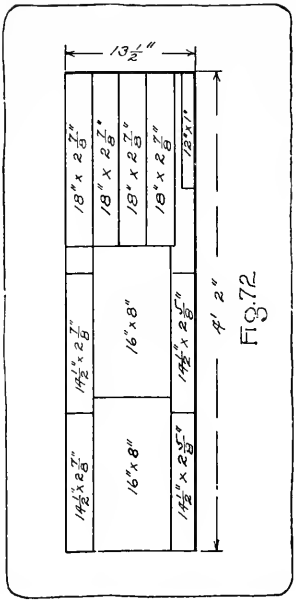


FIG. 72

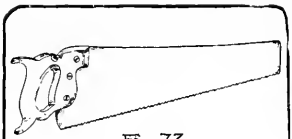


Fig. 73

main parts of the clamps, two pieces of tulip wood 13″x2½″x1¼″ for the blocks of the clamps, a piece of tulip wood 13″x1¾″x1¼″ for the wedges, also twelve 2¼″ No. 14 round-head blue screws and twelve ¼″ washers.

If the chestnut is bought in one large piece it should be laid out with a straight-edge and pencil in the manner and to the dimensions indicated in Fig. 72. Then using the rip-saw (which has teeth sharpened across their entire width like a blunt chisel) cut on the lines running lengthwise of the grain. Many beginners have difficulty in following a line with a rip-saw, but if the saw is in good condition and as soon as the saw begins to leave the line a twisting force is exerted by the wrist in a direction to draw the saw back to the line, ability will soon be acquired to saw quite straight. The cross-cut saw (Fig. 73) should be used in sawing on the lines crosswise of the grain. This saw has teeth that are sharpened on their slanting edges.

The tools to be used the first time are the rip and cross-cut saws, the bevel and the handscrew.

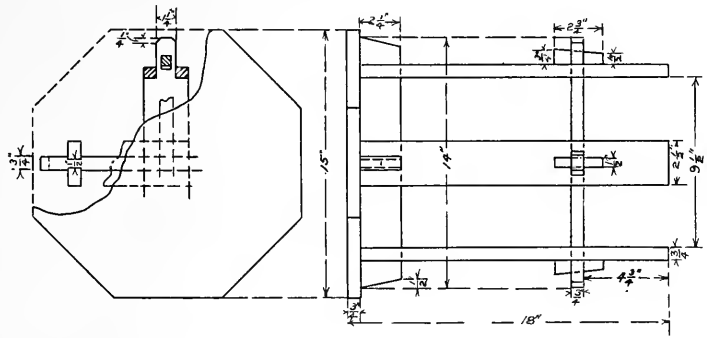
(a) Plane each of the four pieces for the legs by the rules for planing to the length (24), width (3), and thickness (22) given in the working drawing, (Fig. 74.)

(b) Plane each of the two pieces for the lower braces by the rules for planing to length (25), width (3), and thickness (22).

(c) Plane each of the two pieces for the upper braces to width (8) and thickness (22). Then with knife and try-square draw a line across the joint side of one of these pieces about ⅛″ from one

TABORET

Fig. 74.



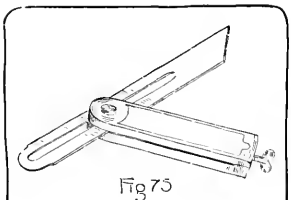


Fig 75

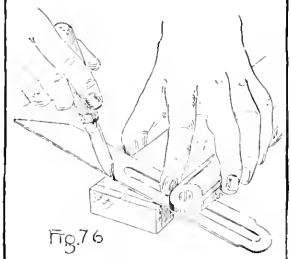


Fig. 76

end, and draw a knife line square across the working face joining with this line. On the edge formed by the working face and the side opposite the joint side, measure toward the middle of the piece ½" from the end of the last line drawn. Place the bevel (Fig. 75), with its blade loosened, on the piece so that the beam is against the joint side, and move the bevel and adjust the blade (Fig. 76) until the edge of the blade passes through the last point located, and the end of the knife line that was made on the joint side. Now tighten the blade in this position, and with the knife, draw a line through the two points referred to. Without changing the set of the bevel, draw another line directly opposite this one, by placing the beam of the bevel against the joint side and the blade on the surface opposite the working face, the line joining with the end of the line on the joint side. Place the beam of the try-square against the working face, and draw a knife line across the side opposite the joint side, joining with the end of the line on the working face. If all of the lines have been drawn carefully this line will join with the end of the slanting line on the opposite surface, thus making a continuous knife line around the piece. Saw with the back-saw a little outside of this line, and block-plane to the line. Measure from the block-planed end on the joint side the length of the brace (25), and through the point so determined, draw a knife line square across the joint side. Without changing the set of the bevel, place the beam against the joint side and draw a knife line on the working face and the surface opposite, joining with the ends of the line on the joint side, and slanting toward the middle of the

piece. Then with the try-square and knife, draw a line across the side opposite the joint side which should make a continuous line around the piece. Saw a little outside of this line and block-plane to the line. In the same manner work the piece for the other upper brace to the desired length with slanting ends.

(d) Clamp the four pieces for the legs in the vise in the following position: The working faces of the front and back pieces should be in contact with the front and back jaws of the vise respectively, and the working faces of the two middle pieces should be in contact with each other. The joint sides of all four pieces should be on top, and should be on the same level. Use the try-square, as in Fig. 77, to bring the ends of all four pieces even. Now from one end, measure on the joint side of one of the legs the distances the lower (26) and the upper (27) edges of the mortise[1] are to be from the bottom of the leg. From the opposite end measure the width (8) of the upper brace. Now placing the try-square as in Fig. 77, make light knife marks even with these points on each edge that the blade of the try-square touches.

(e) Remove the pieces from the vise, and with knife and try-square, draw three lines across the working face of each piece even with these knife marks. Place the try-square on each of the pieces, with its beam against the joint side, its blade on the side opposite the working face and with its edge even with the mark that is $2\frac{1}{4}''$ from the end. Now draw a knife line along this edge of the try-square

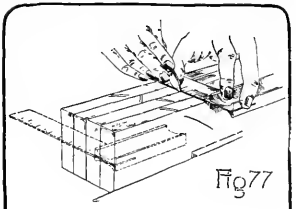
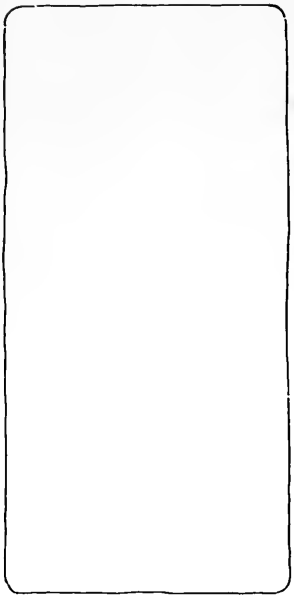


Fig 77

[1] A mortise is a rectangular opening in or through a piece, into which a rectangular projection called a tenon fits to form a joint.



$1\frac{1}{2}$″ long with its nearer end 1″ from the joint side. With the try-square in a similar position draw knife lines even with each of the other two marks $1\frac{1}{4}$″ long, with their nearer ends $\frac{5}{8}$″ from the joint side.

(f) Clamp the four braces in the vise in the same manner as the legs were clamped in d, with the two lower braces in the middle. Measure $1\frac{1}{2}$″ and $2\frac{1}{4}$″ from each end, and before removing the pieces from the vise, draw knife lines square across all of the joint sides even with the two points that are $2\frac{1}{4}$″ from the ends, and across the joint sides of the two upper braces even with the two points $1\frac{1}{2}$″ from the ends.

(g) Remove the braces from the vise and with knife and try-square continue each of the lines square around each piece.

(h) Set the gage equal to the distance (4) from the side of a leg to the nearer edge of the mortise through which the tenon on the lower brace is to pass. Now taking the lower braces, with gage-block against the joint sides, gage lines on the working faces and the surfaces opposite, from each of the knife lines to the ends of the pieces; also gage across the ends. With the same setting of the gage and with the gage-block against the joint side, gage lines on the working face and the opposite surface of each leg between the two knife lines that are respectively $4\frac{3}{4}$″ and $5\frac{1}{2}$″ from the end.

(i) Change the set of the gage to the distance (28) from the side of the leg to the farther edge of the mortise and again follow the directions

for gaging given in h. This completes the laying out of the mortises on the legs and the tenons on the lower braces.

(j) At this point it is desirable to make the keys, and lay out the holes into which they are to fit. To make the keys, plane the working face and the joint side of the piece from which they are to be made, marking these in four different places. Plane off the side opposite the joint side until it is smooth, then gage and plane the piece to thickness (15). Now cut the four keys to their proper length (29). (See Chapter VI, u). Next set the gage to the width (22) that each key is to be at its upper end, and with the gage-block against the joint side, gage a line on one end of each of the four pieces (Fig. 42). Set the gage to the width (15) that each key is to be at its lower end, and in a similar manner gage a line on the other end of each of the four pieces. Connect the ends of these gage lines by using the straight-edge and knife; then plane off the surplus wood outside of these lines, thus completing the four keys.

(k) Lay out the holes for the keys in the following manner: On the working face measure toward the end of the piece $\frac{1}{16}''$ from each of the knife lines that were drawn around the lower braces in g. With the beam of the try-square against the joint side of the piece, draw a knife line $\frac{1}{2}''$ long even with the points thus located and having their nearer ends 1″ from the joint side. By the method used in squaring around a piece, draw on the surface opposite the working face a line directly opposite this one.

Determine the width of a key at a point $1\frac{1}{16}''$ from its wider

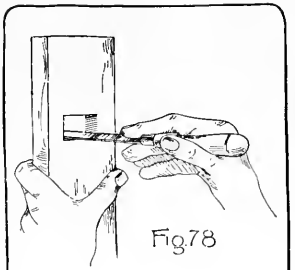


Fig. 78

end, and measure this distance toward the end of the brace from the short line just made on the surface opposite the working face. Draw a knife line $\frac{1}{2}''$ long at right angles to the joint side through this point, having its nearer end 1″ from the joint side. Then determine the width of a key $\frac{5}{16}''$ from its wider end and measure this distance toward the end of the brace from the short knife line on the working face, and through this point draw a line $\frac{1}{2}''$ long at right angles with the joint side and having its nearer end 1″ from the joint side. Set the gage to 1″ and with the gage-block against the joint side gage a line between each pair of these knife lines on both the working face and the surface opposite. Change the set of the gage to $1\frac{1}{2}''$ and with gage-block against the joint side, gage another line between each pair of knife lines. This completes the laying out of the holes for the keys.

(l) To cut out the mortises in the legs, first bore with the $\frac{1}{16}''$ auger-bit two holes within the space that is to be cut out. Start the bit in each case so that the edge of the hole will extend nearly to the gage line locating the end of the mortise, but in no case should the hole extend beyond the gage or knife lines. This boring will remove the greater part of the wood to be cut out, and the remainder may be removed by placing the piece on the chiseling-board and, holding the chisel as in Fig. 63; take thin cuts about half-way through from each side, cutting to within about $\frac{1}{32}''$ of the gage and knife lines Now place the chisel in the lines as in Fig. 56 and by light strokes on the handle, good right-angled corners may be formed as the edges of the mortise. The wood now remaining between these right-angled

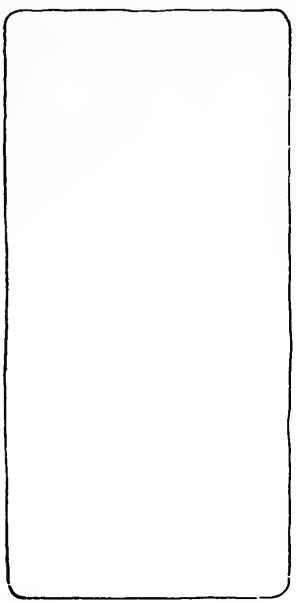
edges should be carefully cut out, testing with a straight edge as, in Fig. 78, to determine when the work is completed.

(m) Cut out the holes in the lower braces for the keys in a similar manner to that described in l, using the $\frac{3}{8}$″ bit and starting the bit in the surface opposite the working face.

(n) To remove the surplus wood from the ends of the lower braces so as to form the tenons, place each piece in the vise in a vertical position and saw with the back-saw a little outside of the gage lines, until the saw cuts within about $\frac{1}{32}$″ of the knife line. Next clamp the piece in a horizontal position in the vise, and saw with the back-saw so that the side of the teeth farthest from the end of the piece cut exactly to the knife line, and saw until the block of wood outside of the tenon is removed. Now carefully pare off the surplus wood which remains outside of the gage lines; also see that good sharp right-angled corners are formed where the two saw cuts meet.

(o) A $\frac{1}{4}$″ chamfer should now be laid out on the edges that are to be vertical at the ends of the tenons. Use pencil and try-square to lay them out, and then cut them with the chisel as in Fig. 63.

(p) Try to insert each tenon in a mortise so that the joint side of the brace and the joint side of the leg come on the same side, with the working face of the brace on top and the working face of the leg on the inside. Do not try to drive the tenon into the mortise; if it cannot be pushed into place without great effort search for the obstruction and remove it. Possibly the brace was not planed to correct thickness or the middle of the inner surfaces of the mortise were not chisel-



ed out enough to form true surfaces. As each tenon is fitted to a mortise it is well to make some mark on the under side of the tenon and the same mark on the inside of the leg near the mortise so that the same tenon and mortise may be put together when the work on the taboret is completed.

(q) For laying out the slot in the upper end of the leg, set the gage to the distance (7) from the side of the leg to the nearer edge of the slot, and with the gage-block against the joint side, gage from the knife line to the end on the working face and the surface opposite, also across the end. Change the set of the gage to the distance (30) the farther edge of the joint is from the side of the leg and gage as before. The wood between these gage lines down to the knife line may be removed by sawing so that the outer edge of the saw teeth come exactly to the gage lines; then bore a hole near the lower end of the slot with the $\frac{3}{8}$″ auger-bit and chisel out the lower end as was done in cutting the mortise.

(r) Set the gage to $\frac{1}{8}$″, and with the gage-block against the working face, gage a line between each pair of knife lines that cross the joint side and the side opposite on each of the top braces. Change the set of the gage to $\frac{5}{8}$″ and, with the gage-block against the working face, gage another line between each pair of lines referred to above. By a method similar to that used in Chapter VI, i to r, remove the wood outside of these gage lines and between the knife lines. This will reduce the thickness between the knife lines to $\frac{1}{2}$″.

(s) Try fitting each thinned part of the upper braces into an

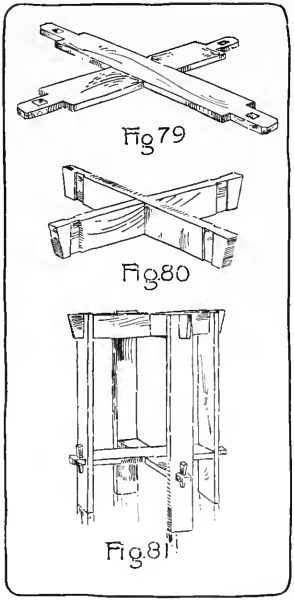
opening in the top of a leg, so that the working face of the brace and the joint side of a leg come on the same side. Observe the same caution about forcing the joints together, as when fitting the tenons in the mortises, and try to discover and remove any obstruction, instead of trying to force the pieces together. When fitted, make marks on each piece so that the same pieces may be fitted together later.

(t) The two lower braces should now be fitted together, as in Fig. 79, with a half lap joint, so that both working faces will be on top; and the two upper braces should be fitted together in a similar manner as shown in Fig. 80, so that both joint sides will be on top. This joining may be done as explained in Chapter VI, d to s, except that the two parts of the cross are not in one piece as they were then. It will therefore be necessary to use special care that all gaging is done either from the working face or joint side.

(u) Now by short knife and gage lines locate on each of the two upper braces on the side opposite the joint side, two points $3\frac{1}{4}''$ from the end of that side and in the middle of its width. With the $\frac{3}{8}''$ auger-bit, bore a hole at each of the points, $1\frac{1}{4}''$ deep. Then with the $\frac{3}{16}$ auger-bit bore on through the remainder of the wood.

(v) With a piece of No. 1 sandpaper wrapped around a block, as in Fig. 64, sandpaper very thoroughly all surfaces of the legs, braces and keys. In doing this rub lengthwise of the grain where possible. Then put the entire frame together as in Fig. 81.

(w) To prepare a clamp for use in gluing up the top, first plane a working face on each of the two pieces of "two by four". Next



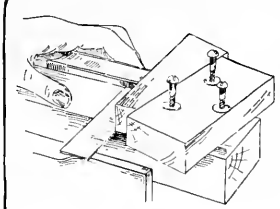
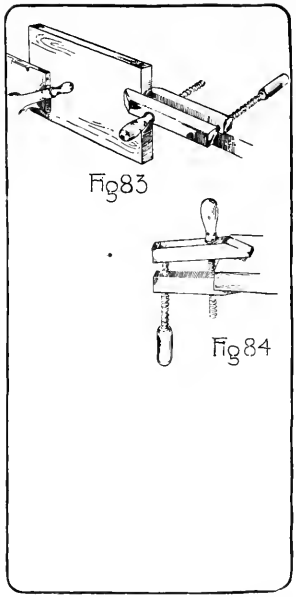


Fig 82

plane, by the rules for planing, four blocks 6″x2¼″x1⅛″. Also make two wedges of the same form as the keys made in j each 6″ long, 1½″ wide at one end, 1″ wide at the other end and 1⅛″ thick. Now locate and bore three ¼″ holes in each of the four blocks made above, two of them being ⅝″ from the joint side and 1¾″ from the ends, and the third 1½″ from the joint side and in the middle of the length. One of these blocks should now be fastened to each of the long pieces near one end, using three 2¼″ No. 14 round-headed screws and washers. To find the correct location for the blocks on the working face of the long pieces use one of the wedges and the try-square as in Fig. 82, and by striking the screws with a hammer, points will be located where the screws should enter. Use the $\frac{1}{32}$″ twist-bit, and bore a hole at each of these points, 1⅛″ deep. The blocks may now be screwed fast. The other two blocks being fastened in place as shown in Fig. 86, the clamps are now ready for use.

(x) The top of the taboret is to be made of two pieces and should be glued together as follows: Plane the working face of each of the two pieces for the top. In selecting the surface to be planed for the working face of each piece it is desirable to use the surface that was nearer the center of the tree from which it was cut, for one of the pieces, and for the other the surface that was nearer the bark; this may be determined by observing the rings of growth on the ends of the pieces. By arranging the pieces in this manner the tendencies in the two pieces to warp counteract each other. Next, plane an accurate joint side on each piece. If the piece is clamped in the vise

in the usual way it is too high and unsteady for convenience in planing, and it is therefore advisable to fasten a hand screw to one end of the piece and clamp the piece in the vise as in Fig. 83. Beginners usually find considerable difficulty in managing a handscrew, but if it is remembered that the two jaws should never be far from parallel, little difficulty need be experienced. In adjusting the handscrew to any work, it should be brought to a position such as is shown, somewhat exaggerated, in Fig. 84; then by tightening the end screw, the jaws may be brought to a parallel position. Some experience will be necessary to determine how tight the middle screw should be in order that the jaws may be parallel when the end screw is tightened. When the two joint sides are completed, clamp one piece in the vise with the working face to the front and the joint side up, and on this place the other piece with its working face to the front and its joint side in contact with the joint side of the other piece. This will show whether the working faces and joint sides of the two pieces have been accurately planed or not; for if these are not correct there will be openings between the joint sides, or the working faces will be shown to be out of line when tested with a straight-edge (Fig. 85). If the joint is not a good fit apply the tests again to the working faces and joint sides, and make corrections where needed. It is not an easy matter to make a good glue joint but perseverance will accomplish it. When the joint is fitted, place the pieces for the top of the taboret on the clamps with their working faces down, and with the wedges in the position shown in Fig. 86, fasten the loose



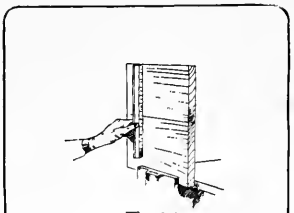


Fig. 85

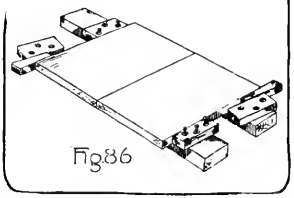


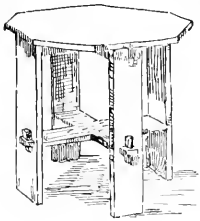
Fig 86

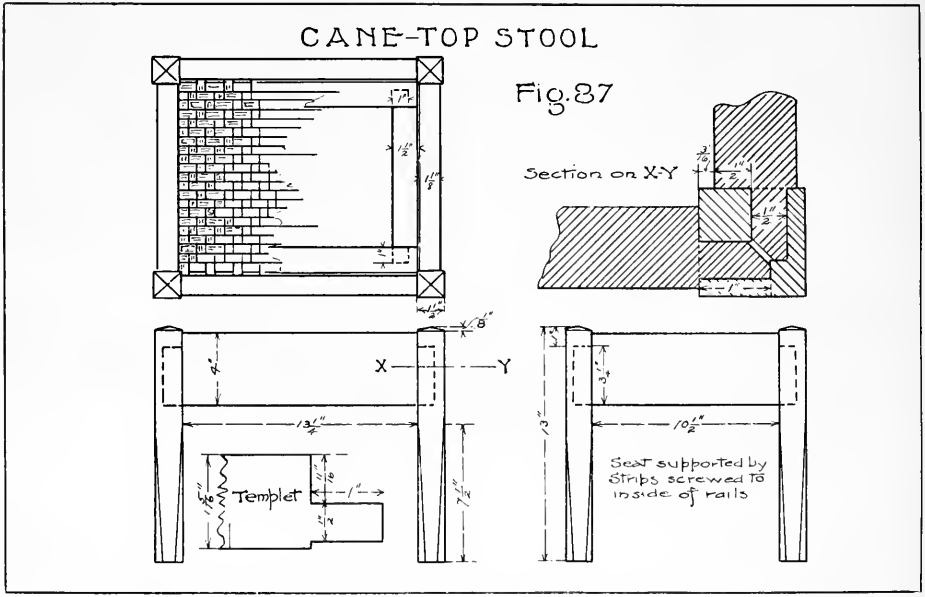
blocks in position by the method explained in w. Next drive the wedges in between the blocks and pieces to make sure that the joint is ready for gluing; then remove the wedges, cover both of the joint sides with a thin coat of liquid glue and again clamp the pieces together, using care that the working faces and ends of the two pieces are in line. It is best to leave the pieces in the clamps ten or twelve hours.

(y) After removing the clamps the piece should be planed by the rules for planing to the following dimensions 15″x15″x$\frac{3}{4}$″. Next draw a light pencil line diagonally across the square on the working face and measure from each corner along each side and end, a distance equal to one-half the length of this diagonal, and with the beam of the try-square against the working face, draw pencil lines square across the sides and ends at each of these points. With the straight-edge and knife draw lines on the working face diagonally across each corner connecting the ends of the two pencil lines which are adjacent to the corner. These lines, with parts of the sides of the square, form a regular octagon. Now clamp the piece in the vise and saw off the corners nearly to the knife lines; then block-plane to the lines. Next lay the octagonal piece on the bench with the working face up and place the frame (Fig. 81) wrong side up on it so that the center line of the joint side of one of the braces is in contact with the diagonal previously drawn and with the two ends of this same brace at equal distances from the sides of the octagonal piece. Place the four 1$\frac{1}{4}$″ No. 10 round-head screws in the holes in the braces; then using the nail set, wrong end up, to reach them,

strike each lightly to locate the points for the holes in the top. Now with the $\frac{1}{32}''$ twist-bit bore holes $\frac{1}{2}''$ deep at each of the four points located. The frame may now be screwed to the top and the taboret is ready for the finish.

(z) To finish the taboret, secure a barrel and if there are cracks in it paste paper over the outside of them to make it as near air-tight as possible. Pour about two ounces of strong ammonia in a dish and set the taboret over it; then invert the barrel over the taboret, closing all openings around the edge of the barrel. If the ammonia is as strong as it should be, it will be necessary to have everything ready for quick work before pouring it into the dish and then care should be taken that the fumes do not choke you. Let the taboret remain in the fumes at least fifteen hours and then remove the barrel and allow some time for the fumes to escape. Now shake the bottle containing the boiled oil and hard-oil finish and with a cloth thoroughly rub it on and into all parts of the taboret.




CANE-TOP STOOL
Fig. 87
Section on X-Y
X
Y
Templet
Seat supported by Strips screwed to inside of rails

CHAPTER IX.

Furniture Making—Closed Mortise-and-Tenon Construction.

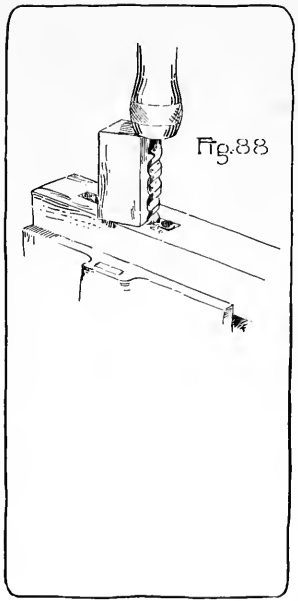
In this chapter the application of the fundamental principles to furniture making is continued, and a good working knowledge of construction involving the closed mortise-and-tenon joint should be gained. This method of construction is in general use, and with good workmanship is unexcelled for strength.

Cane-Top Stool (Fig. 87). The material required consists of four pieces of oak 14″x1¾″x1¾″ for the legs, two pieces 16″x4¼″x1¼″ and two pieces 13″x4¼″x1¼″ for the rails, two pieces 12½″x1½″x⅞″ and two pieces 10″x1½″x⅞″ for the supports for the seat, two pieces 14″x1¾″x1″ and two pieces 10½″x1¾″x1″ for the seat frame, a piece of hard maple 8½″x1½″x¼″ for the templet, ten 1½″ No. 10 flat-head bright screws for fastening the supports for the seat, 55 yards of pith cane, a small bottle of liquid glue, a 2-oz. bottle of fumine, a 2-oz. bottle of strong ammonia, and about 1 oz. of four parts boiled oil and one part hard-oil finish.

The tools to be used for the first time are the cabinet scraper and the needle for weaving the seat.

(a) Plane the four pieces for the legs by the rules for planing to dimensions. (31, 30, 30.)

(b) Clamp these four pieces in the vise, as in Fig. 77, and measure the distance (7) from the top of the leg to the upper end of the mortise, and from the point just located, measure the length (32) of the mortise.



With the beam of the try-square against the working face of the front leg, make light marks on each edge that is formed by a working face and joint side.

(c) Remove the pieces from the vise, and place the try-square on one of the legs with the beam against the working face and the blade on the joint side, its edge being even with one of the last marks made. Now make a knife line as long as the width (15) of the mortise, its nearer end being as far (1) from the working face as the nearer edge of the mortise is to be from the inner edge of the leg. Using the same point on the edge of the leg, draw a knife line of the same length, and in a similar manner, on the working face, its nearer end being the same distance from the joint side as the end of the line just drawn was from the working face. In the same manner as above, make two similar knife lines even with each of the seven remaining points that were located on the edges of the legs.

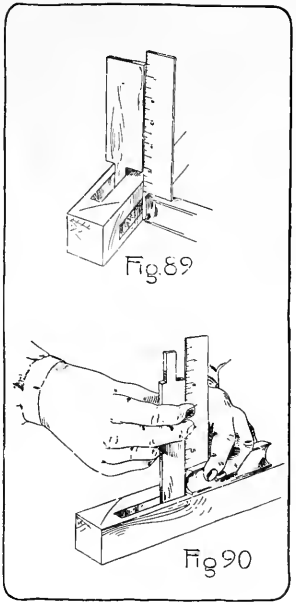
(d) Set the gage to the distance (1) that the inner edge of the mortise is to be from the inside of the legs, and with the gage-block against either the working face or joint side, gage lines between each pair of knife lines that indicate where the ends of the mortises are to be. Change the set of the gage to the distance (33) the outer edge of the mortise is to be from the inside of the leg, and in a similar manner, make another gage line between each pair of knife lines. This completes the laying out of the mortises.

(e) Using the $\frac{3}{8}$″ auger-bit bore eight or nine holes within each of the spaces just laid out, to the depth (7) the mortise is to be cut.

This may be done by the method shown in Fig. 65, but may be accomplished more rapidly by cutting a block the length of the exposed part of the bit when the hole is to the required depth, and placing it beside the bit when boring. When the chuck strikes the top of the block, as in Fig. 88, the hole is to depth. The wood remaining in the mortises is to be removed by a method similar to that explained in Chapter VIII, 1. By working at the same time on both mortises that are in one leg, the chisel may be entered in one while trimming the bottom of the other to its correct depth.

To test the mortise while chiseling it out, make from the thin piece of hard maple, an accurate templet of the size and form shown in Fig. 87, and use it as in Fig. 89. It should not be forced into the mortise, but if used carefully and thoughtfully, the part to be chiseled out may readily be determined. To ascertain whether the end of the mortise is being cut square with the surface, use the try-square and any straight-edge, as the joint side of the templet, Fig. 90.

(f) To form the point on the top of each leg, proceed as follows: With knife and try-square, draw a light line around each leg $\frac{1}{8}$" from its upper end; then with the pencil and gage used as in Fig. 37, on the upper end of the leg draw a line through the center parallel to the working face, and a similar line parallel to the joint side. Clamp each leg in the vise in a vertical position and block-plane a chamfer extending from the line on the side opposite the joint side to the line on the end parallel with the joint side. Test to see that the surface of this chamfer is square with the working face. In a similar



manner plane a chamfer from the line on the surface opposite the working face to what remains of the line parallel to the working face. Next plane a chamfer from the line on the joint side to what remains of the line parallel to the joint side. Finally plane a chamfer from the line on the working face up to the point which is now formed in the center of the end.

(g) To form the lower part of the legs, first lay out a regular octagon on the lower end as in Chapter VIII, y; then locate a point on each edge of the leg 7½″ from its lower end, and from each of these points, with pencil and straight-edge, draw lines to the angles of the octagon that was laid out on the bottom of the leg. With the jack-plane, take off the wood outside of these lines. In doing this planing, it is desirable to clamp the legs in the vise as in Fig. 71, and it is necessary to protect the edges from injury while they are clamped in this position. To do this, place pieces of soft pine between the edges and the jaws of the vise.

(h) Plane the two longer rails to length (34), width (35) and thickness (10) and the two shorter rails to length (36), width (35) and thickness (10).

(i) Clamp the two longer rails in the vise as in Fig. 77, and measure from each end the length (7) of the tenons. At the points thus determined, draw knife lines square across the joint sides. Remove the pieces from the vise, and continue the knife lines square around the pieces. In a similar manner draw knife lines square around the two shorter rails as far from each end as the length (7) of the tenons.

(j) Set the gage to the distance (15) that the inner surface of the tenon is to be from the inner surface of the rail, and with the gage-block against the working face of each of the four rails, gage lines for the inner surfaces of the tenons. Change the set of the gage to the distance (7) the outer surface of the tenon is to be from the inner surface of the rail, and gage for the outer surface of the tenons. Now set the gage to the width (32) of the tenon, and with the gage-block against the joint side, gage lines for the width of the tenon on the working faces and surfaces opposite, also across the ends. This completes the laying out of the eight tenons.

(k) To remove the surplus wood outside of the tenons, clamp each rail in the vise in a vertical position and saw with the back-saw so that the inner edges of the saw teeth cut exactly to each gage line. Next holding the piece on the bench-hook, saw to the knife lines. Make all of the three saw cuts to the gage lines of each tenon before sawing to the knife lines. If the sawing has been well done no chiseling will be necessary, except a little to clean out the angles where the saw cuts meet. Fit each tenon in a mortise without too great force and mark it. Clamp each end and each side together, as in Fig. 91, changing the position of the back blocks to suit each case and testing with the try-square to ascertain if the legs are square with the rails; also see that the shoulders on the rails fit tight against the legs.

(l) Remove the tenons from the mortises and lay out and cut a chamfer on each tenon, the lines for its edges being $\frac{3}{8}$" both ways

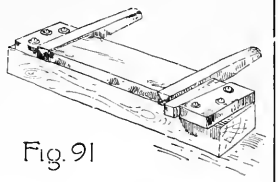


Fig. 91

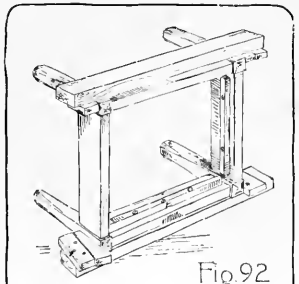


Fig. 92

from the inner edge of the tenon. Plane the two pieces for supporting the seat to 12″x1¼″x¾″ and screw them with three 1½″ No. 10 screws to the inside of the two longer rails, as shown at E, Fig. 92, with the upper side of the support ⅜″ below the top of the rail. In a similar manner plane the other two pieces to 9¼″x1¼″x¾″ and screw them with two screws to the inside of the shorter rails.

(m) Apply a thin coat of liquid glue to the tenons and the shoulders around the tenons on one of the end rails, also on the surfaces within the mortises that will be in contact with the surfaces of these tenons. Then put one end of the stool together and clamp it as in Fig. 91. Glue up the other end of the stool in a similar manner. They should be left in the clamps ten or twelve hours, but it is well after they have been in the clamps about three hours to clean off any glue that has squeezed out around the joint or into the other mortises in the legs.

(n) Make sure that the stool will clamp together, as in Fig. 92, all joints closing up well. Then apply a thin coat of liquid glue to all of the remaining tenons and mortises, and clamp the stool together as in Fig. 92. Test to see that the two pairs of diagonally opposite legs are the same distance apart, and if they are not, try to force the two legs that are farthest apart nearer together. They may be held in this position by a stay placed diagonally across the stool and nailed to the sides of the main pieces of the clamps.

(o) After ten or twelve hours the clamps may be removed. All of the surfaces should then be scraped with a cabinet scraper. This is a rectangular piece of steel about 1/16″ thick. Holding the

scraper as in Fig. 93, draw it toward you, applying a downward pressure as it is drawn forward. It will be possible by this method to remove the slight irregularities in the surface that are nearly always found in oak after planing and which if left in the surface are especially noticable after the finish is applied. After scraping all surfaces they should be rubbed thoroughly with No. 1 sandpaper, using a block as in Fig. 64.

(p) Plane two pieces of oak for the seat frame to $13\frac{5}{8}''$x$1\frac{1}{2}''$x$\frac{7}{8}''$ and the other two to $9\frac{7}{8}''$x$1\frac{1}{2}''$x$\frac{7}{8}''$.

(q) Clamp the two longer pieces in the vise as in Fig. 77, and draw two knife lines across the joint sides for the ends of each mortise, one $\frac{1}{2}''$ and the other $1\frac{1}{2}''$ from the ends of the pieces. Next clamp the two shorter pieces in the vise as in Fig. 77 and draw knife lines across the joint side $1''$ from each end. Remove these pieces from the vise and continue these lines square around each piece. Set the gage to $\frac{1}{4}''$ and with the gage-block against the working face, gage between the lines for the ends of the mortises on the longer pieces; and from the line around each end of the shorter pieces, gage lines to and across the ends of the pieces. Now change the set of the gage to $\frac{5}{8}''$ and gage again as above with gage-block against the working face. Next set the gage to $1''$, and with the gage-block against the joint side of the shorter pieces, gage from the knife lines to and across the ends.

(r) The mortises may now be cut as in e except that there will be more difficulty in cleaning out the bottom of the mortises. It is advisable to clean them out before cutting to the knife lines at the

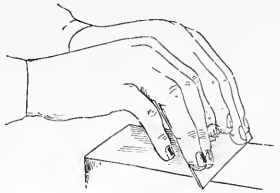
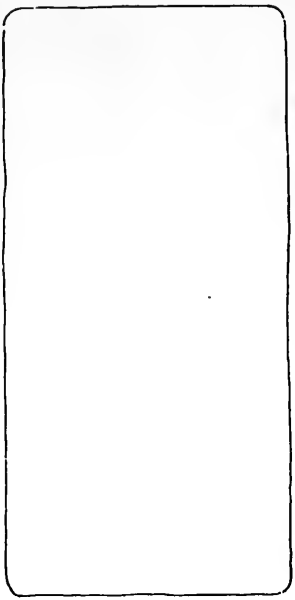


Fig. 93



ends of the mortise. The wood may be cut away from the outside of the tenons as explained in k The tenons may then be fitted in the mortises and marked, remembering that the working faces of all the pieces are to be on the same side of the frame. Clamp the entire frame together with the clamps used for the stool. Then test the frame with the winding-sticks, and if there is a wind in it, a little thoughtful work on some of the tightest joints may take the wind out. Now apply glue to the tenons and in the mortises, and clamp the frame together.

(s) When the glue is dry and the frame out of the clamps, any wind remaining in it should be planed out. Then set the gage to the same distance as the thickness of the frame in its thinest part, and gage around the frame with the gage-block against the true surface; then plane the frame down to the gage line. The stool should now be placed up-side down on the seat frame, and when as centrally placed as possible, make marks with a knife on the frame even with the inside surfaces of all four legs. It is also well to make a mark on the frame and on the inside of a rail, so that the frame may be placed in this same position later. Right-angled notches should be laid out even with these marks and sawed out. All four sides should now be planed off so as to leave a $\frac{1}{16}$″ space for the cane between the outside of the frame and the inside of the rails. Next bore two $\frac{3}{8}$″ holes $\frac{3}{4}$″ deep and $1\frac{1}{4}$″ between centers in the under surface of the frame near the middle of the length of each end piece and one near the middle of the length of each side piece, all six of the holes

being $\frac{7}{16}$″ from the outer edge of the frame. Now lay out and plane a $\frac{1}{8}$″ chamfer on the upper and lower edges entirely around the outside of the frame, and with a chisel make a similar chamfer on the upper and lower edges on the inside of the frame. By a method similar to that used in planing the roller of the towel roller, change these chamfered edges on both the inside and the outside of the frame into rounded edges. The frame should now be scraped and sandpapered.

(t) Now make four round pegs about $1\frac{1}{2}$″ long, using the dowel plate as in Chapter II, o. Clamp each one in a vertical position in the vise, and with the back-saw, make a cut at least $\frac{3}{4}$″ deep down through the center of the peg. Then measure and saw off a length of $\frac{3}{4}$″ from the end just sawed. This makes two parts of each peg, and when the end of one part is rounded, they are used, as in Fig. 94, to fasten the ends of the cane.

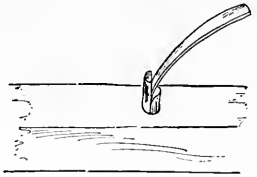


Fig. 94

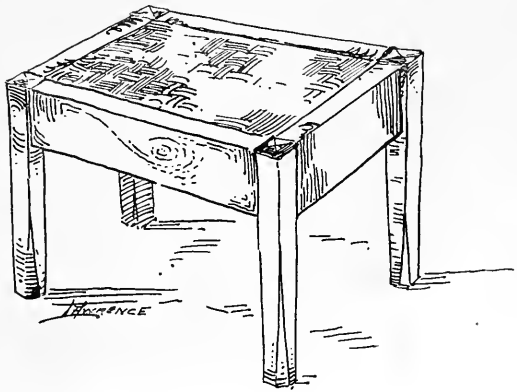
(u) Before starting to put on the cane the fumine should be put in a dish and five times as much water as fumine added. It should then be applied with the brush to all parts of the stool and the seat frame. What remains should be kept to apply to the weaving. The fumine will be dry enough in ten or fifteen minutes to begin putting on the cane.

(v) The cane should be soaked in water at least two hours before using, and it is well to plan the spacing of the cane and mark on the frame where each strand is to be, in order that the outer cane may come close against the legs and that there may be a space of about $\frac{1}{16}$″ be-

tween adjacent strands. Apply a little glue to one of the pegs and drive it in one of the holes in a side of the frame (Fig. 94) with an end of a cane between the parts of the peg in such a position that the smoother side of the cane will be on the outside of the seat. The cane should now be passed around the frame lengthwise (Fig. 95), drawing it snug but not too tight, and tying together the ends of successive pieces of the cane so that the knots will be on the under side of the frame. When the other side of the frame is reached, the end of the cane should be fastened as when starting.

(w) A piece of cane to run crosswise may now be fastened in one of the holes in the end of the frame, sliding two of the lengthwise strands apart to get at one of the holes. With a knife reduce the width of the cane near the other end, (see Fig. 96) and by folding the wide part at the end, thread it in the weaving needle. Now pass the needle under every fourth strand on the bottom of the seat, and on the top weave over one and under two; each succeeding time around, begin to weave one strand before the corresponding one the last time (Fig. 96). The final end should be fastened as the others, with a peg in one of the holes.

(x) The fumine as mixed in u should now be applied to the weaving, using care that all parts of the cane exposed are covered. The stool should now be fumed with ammonia and rubbed with the mixture of boiled oil and hard oil finish, as explained in Chapter VIII, z.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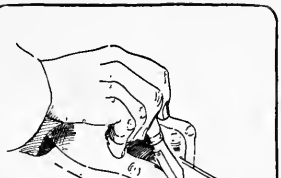

Fig 97

CHAPTER X.

Application of Principles.

The work outlined in the preceeding chapter has given experience in only a few of the problems a woodworker will have to meet, but the work has been presented systematically and it is believed that most workers, after completing this work, will be able to master ordinary problems in woodworking. The purpose of this chapter is to call attention to some of the principles explained in the preceeding chapters, and give some general suggestions for their application to other problems.

Laying Out. The pencil should be used for laying out work only when there is a good reason why it is better than the knife and gage,

The pencil should be used in laying out work on rough surfaces, as when framing buildings and in getting out stock from rough material, because knife lines can not readily be seen on such surfaces.

The use of the pencil should not, however, in these or other cases be an excuse for inaccurate work, for it should be the aim at all times to be as accurate as possible. It is also best to use the pencil when laying out lines for obtuse-angled edges, as was done when making the chamfer on the bread-cutting board and in making the slanting surfaces on the end pieces of the towel roller. Still another use for which the pencil is especially suited is in laying out curves.

In general, except as noted above, the gage and knife should be used. This is especially necessary where any accurately fitted

joints are to be made, and in such cases it is necessary that the beam of the try-square and the gage-block be used only against the working face or joint side. A bevel-edge rule has been advised because it is easier for a beginner to use, but when using a thick-edge rule, such as is in more common use, it should be held on its edge as shown in Fig. 97.

Planing. In planing lengthwise of the grain the most important planes used are the smooth-plane, jack-plane and the jointer-plane. These are mentioned in the order of their length.

If a thick shaving is desired, as when roughing out work, the jack-plane should be used; it has an iron with the edge sharpened as shown in Fig. 98. This plane is of convenient length, and when the blade is sharpened in this manner, a thick shaving may be taken off much easier than when the iron is ground as in Fig. 99. This does not leave a good smooth surface, and therefore its use should be followed by one of the other planes.

If smoothness of surface instead of trueness is desired it may be produced more quickly by using the smooth plane which is a short plane and has a plane-iron sharpened as shown in Fig. 99. On account of the shortness of this plane it reaches the depressions in the surface, thus smoothing the entire surface quickly.

For planing large surfaces so that they are both true and smooth a jointer-plane is desirable. This is a long plane having its iron sharpened as in Fig. 99. Its length prevents the blade from cutting any from the parts which are too low, but does allow the blade to

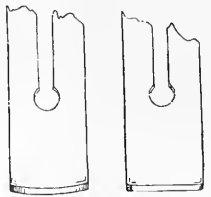

Fig. 98 Fig. 99

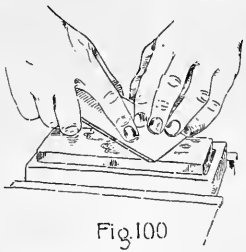

Fig. 100

cut from the parts that are too high, thus tending to make a true surface. If two long pieces are to be glued together in the same manner as the top of the taboret, the use of the jointer-plane is very desirable in fitting the joint.

For the nonprofessional woodworker who is not doing a large amount of work and is not working on very large pieces, the work requiring these three planes may be very well accomplished by providing two plane-irons for the jack-plane, one sharpened as in Fig. 98 and the other as in Fig. 99. Many other planes for special purposes are used occasionally, but they will present little difficulty to the thoughtful worker who has followed the course as given.

The rules for planing as outlined in Chapter IV are followed when a piece is to be brought to a given length, width and thickness. The order of the steps there outlined should never be changed, but in certain cases some of the steps may be omitted. Thus in making the coat hanger it was not desirable to plane the piece to width. Occasionally a problem appears in which the planing to thickness is not desirable, and in such problems as modeling a hammer handle or canoe paddle the planing to both width and thickness may be omitted. The winding-sticks are not usually a part of the professional woodworker's outfit; he determines whether there is a wind in the working face either by sighting across the surface itself or by placing the surface in contact with some surface he knows to have no wind in it.

Chiseling. The systematic method of chiseling followed in this book may seem unnecessary to beginners, but if followed, its advantage

over chiseling at random will soon be appreciated. There are two kinds of chisels in common use: The firmer chisel, being rather light in construction, is intended for hand work only; the framing chisel is stronger in construction and may be used with the mallet for heavy framing work.

Furniture Construction. A considerable amount of skill is required to make a good single joint such as was used in making the flower pot stool, but as the number of joints in a piece increase, the difficulty of making usually increases; that is, the fit of one joint in a piece of furniture usually requires some other joint or joints to be in a definite position with reference to it. For this reason great care is necessary in planning and laying out pieces of furniture. When possible, have the working faces and joint sides in such position that their surfaces shall serve as parts of the joints, as they are more likely to be true than the surfaces opposite.

Another fact that should be taken into consideration in furniture construction is that wood swells and shrinks, due to the changes of moisture in the air. Changes due to this cause are very slight lengthwise the grain, but they are sufficient to require consideration when crosswise the grain. There is a strong force causing this change and in constructing furniture it is best whenever possible to arrange so that this force can act without effecting the completed piece. The method usually employed to provide for this is known as panelling, and it should usually be employed where the parts are more than six or eight inches wide. It consists in making a frame similar to

Fig.101

that used for the seat of the cane top stool, with groove around on the inside of the four pieces of the frame, into which a thinner piece called the panel is inserted before the frame is glued up. The panel should lack at least an eighth of an inch of being wide enough to fill the space allowed for it and when gluing up the mortise and tenon joints of the frame care should be used that no part of the panel is glued fast in the groove. After gluing it up this may be treated as a single piece and will not change in size but the panel may swell or shrink within the frame.

APPENDIX.

Dimensions. The dimensions given in the list below are those which should be used in place of the corresponding reference numbers in the text. All dimensions might have been omitted both from the text and the appendix; in that case the worker would have been obliged to study the working drawings to determine the dimensions. This method was not followed for fear some beginners might become discouraged before acquiring ability to read the working drawings. If all the dimensions had been given in the text, the worker would not have been encouraged to study the working drawings at all. This would have been equally undesirable. It is expected that a worker will refer to this list only when unable to determine the dimension from the working drawing or when he wishes to see if he has determined the correct dimension.

1— $\frac{1}{16}''$	13— $2\frac{3}{8}''$	25—14″
2—15½″	14— $\frac{1}{4}''$	26— $4\frac{3}{4}''$
3— $2\frac{1}{2}''$	15— $\frac{1}{2}''$	27— $5\frac{1}{2}''$
4— $\frac{5}{8}''$	16— $1\frac{3}{8}''$	28— $17\frac{3}{8}''$
5— $1\frac{5}{8}''$	17—$18\frac{3}{4}''$	29— $23\frac{1}{4}''$
6— 5″	18— $3\frac{1}{8}''$	30— $11\frac{1}{2}''$
7— 1″	19— $13\frac{1}{4}''$	31— 13″
8— $2\frac{1}{4}''$	20— $\frac{7}{8}''$	32— $31\frac{1}{4}''$
9— $7\frac{3}{4}''$	21— $\frac{7}{16}''$	33— $1\frac{3}{16}''$
10— $1\frac{1}{8}''$	22— $\frac{3}{4}''$	34—$15\frac{1}{4}''$
11— $1\frac{1}{4}''$	23—$17\frac{3}{4}''$	35— 4″
12— 6″	24—$17\frac{1}{4}''$	36—$12\frac{1}{2}''$

Planes. Planes are the most complicated of the ordinary woodworking tools and a more detailed explanation than was considered desirable in the text will now be given.

Jack-plane. To take this plane apart, raise the lever Q, Fig. 24, then slide up the cap L until the enlarged opening in it will allow it to be slipped over the head of the screw passing through it. The double plane-iron may now be removed. Great care should be used in removing and replacing this double plane-iron, that the sharpened edge be not injured by coming in contact with the other metal parts of the plane. The plane-iron is a steel blade about one-sixteenth of an inch thick; its general shape is rectangular, and along a portion of its length extends a slot with an enlarged circular opening at one of its ends; its sharpened edge is formed by a bevel across one end. To the surface of the plane-iron that is not beveled the plane-iron cap is attached by means of a screw passing through the slot in the plane-iron. This plane-iron cap serves to stiffen the plane-iron and also to break the shaving, so that in wood with irregular grain the shaving will not act as a lever and break ahead of the cutting edge, thus leaving a rough surface. In adjusting this cap to the plane-iron, its thin end should be tight against the plane-iron and usually about $\frac{1}{16}''$ from its sharpened end. For cutting thick shavings, when using the plane-iron ground as in Fig. 98, this distance may be as much as $\frac{3}{16}''$. When smooth work is desired in finishing a piece with irregular grain, the plane-iron, ground as in Fig. 99, should be used with the cap

set less than $\frac{1}{32}$" from the sharpened edge, and should cut a thin shaving. When placing the double plane-iron in position, the circular disc on the end of the lateral adjustment lever should enter the slot in the plane-iron; the end of the lever operated by the adjusting nut should enter the small rectangular hole in the plane-iron cap; and the plane-iron itself should be in contact with the frog. To hold the plane-iron in this position, the cap L, Fig. 24, is slipped into position and the lever Q pushed down as shown in Fig. 24.

Block-plane. Several of the parts of the block-plane shown in Fig. 26 serve the same purpose as those in the jack-plane, but there is no plane-iron cap; the adjusting nut is placed in a different position, and the cap S is fastened by a lever moving sidewise, instead of in a vertical direction. The plane iron is placed with the bevel on top instead of underneath, as in the jack-plane, and on its under side has a series of grooves extending crosswise. It is necessary that the proper one of these engage in the teeth of the adjusting lever or the turning of the adjusting nut will not bring the sharpened edge of the plane-iron into the correct position for planing.

Some block-planes have a device as shown at W, Fig. 26, for the adjustment of the width of the mouth. By loosening the thumb screw slightly, the cam lever is released so that it may be moved to the right or left, thus varying the width of the mouth. A wide mouth is better when taking a heavy cut, especially in soft wood, and a narrow mouth is better when taking a light cut, especially when working with hard wood.

Sharpening. When the planes or chisels require considerable force to operate them or if the surface produced when using them is not smooth, it indicates that the tool needs sharpening. Unless the bevel on the tool is considerably rounded or the edge badly nicked it will be sufficient to sharpen it on the oilstone. This is done as follows: Place a drop or two of sperm oil on the oilstone and hold the chisel or plane-iron as in Fig. 100, with the upper end so low at first that the sharpened edge is not in contact with the stone. Now raise the upper end until the bevel barely comes in contact with the stone. This position may be easily determined by noticing that the oil is squeezed out from under the bevel as it is raised to this position. It should now be moved with a circular motion on the surface of the stone, the upper end of the tool at all times being kept the same distance above the top of the oilstone. It is best not to continue this sharpening very long at one place on the oilstone. To determine when this part of the sharpening is completed draw the finger along on the surface of the iron that is not beveled from near the end of the slot to the sharpened edge. If a fine turned-up edge of steel is felt as the finger reaches the sharpened edge this part of the sharpening process has been continued long enough. The surface of the iron that is not beveled should now be laid flat on the stone and the iron moved with a circular motion until the turned-up, or wire edge, as it is called, seems to be ground off. There still remains a fine wire edge which is very difficult to see. For removing this, a piece of leather fastened to a flat surface should be provided,

and the iron held upon it as in Fig. 100, and drawn toward you several times. It should then be turned over and treated in a similar manner. This strapping should be repeated several times until the fine wire edge has disappeared. With careful work the iron may be made sharp enough to cut a hair.

If, when the bevel on a tool is tested with a straightedge, as the chamfer in Fig. 39, it is found to be considerably rounded or if the sharpened edge has become badly nicked, the tool should be ground on the grindstone. To do this, hold the tool, as in Fig. 101, against the front side of the grindstone, with the stone revolving toward you. In order to bring the tool to a correct position for this grinding, it is advisable to hold the unsharpened end of the tool low, when first placing it on the stone; then gradually raise it untill the sharpened edge of the tool is nearly but not quite in contact with the surface of the stone. If you stand close to the stone and lean the body over above the tool you can see this opening between the edge of the tool and the stone, appearing as a fine dark line; and watching this, you may keep the tool in this same position by keeping this dark line the same. It is essential that the tool be kept at the same angle with the surface of the stone during the entire sharpening process, and if removed from the stone it is necessary that it be returned to the same position. A slight swaying motion of the tool from right to left is also desirable. Beginners should concentrate their attention on keeping the tool in the correct position, and should not apply too much pressure to it. When grinding chisels or planes, except as in Fig. 98, it is essential that the edges be straight, and to insure this a straight piece of wood should occasionally be used to test the edge while grinding it. When this grinding is completed, if the test shown in Fig. 39 is applied, the bevel will be found to be straight, and by drawing the finger toward the edge on the surface that is not beveled, it will be found that a wire edge has been formed; this may be removed on the oilstone as explained above, and then the entire directions for sharpening on the oilstone should be followed. When sharpening a plane-iron as in Fig. 99, about $\frac{3}{16}$″ on each end of the sharpened edge should be rounded back slightly before applying it to the oilstone.

List of Tools

Good (H or No. 3) lead pencil (Fig. 30).
Marking Gage (Fig. 8).
Sloyd knife (Fig. 11).
Try-square (Fig. 10).
Bevel-edge rule (Fig. 14).
Bench hook (Fig. 15).
Back-saw (Fig. 16).
Brace (Fig. 18).
[1] Auger bits, $\frac{3}{16}$″, $\frac{1}{4}$″, $\frac{3}{8}$″, $\frac{1}{2}$″, $\frac{11}{16}$″ (Fig. 19).
[2] Dowel plate (Fig. 20).
Mallet (Fig. 20).

[1]Two parallel marks placed above and to the right of a number indicate inches (as 7″), and a single mark similarly placed indicates feet (as 6′).

[2]The dowel plate may be made by grinding smooth one side of a piece of cast iron or steel about $\frac{5}{8}$″ thick and drilling two holes through it, one of them $\frac{7}{16}$″ in diameter, and the other $\frac{17}{128}$″.

Jack-plane (Fig. 24). An iron one is preferred, and the plane iron should be ground as shown in Fig. 99.

Block-plane (Fig. 26).

Winding-sticks (Fig. 33).

Turning saw (Fig. 44).

Spoke-shave (Fig. 47).

Twist-bit $\frac{4}{32}$″ (Fig. 48).

Firmer chisels, $\frac{5}{16}$″, 1″ (Fig. 56).

Hammer (Fig. 67).

Nailset (Fig. 59).

Countersink (Fig. 61).

Compasses (Fig. 62).

Screwdriver (Fig. 68).

[1] Rip-saw.

[1] Crosscut saw (Fig. 73).

Bevel (Fig. 75).

Handscrew, 8″ jaws (Fig. 84).

Cabinet scraper (Fig. 93).

Needle for weaving seat of stool (Fig. 96).

Oilstone (Fig. 100).

Brush for cleaning bench.

List of Material

Two pieces of tulip wood[2] 8″ long, planed by machine to a width of 4″ and thickness of $\frac{3}{4}$″ (one of them for the game board, the other to be used as a practice piece).

[1] This saw is very desirable to have in an outfit of tools, but is not necessary for the work given if the material is cut to size when purchased.

[2] The wood of the tulip tree is seldom called by its own name, but is called white wood in some parts of the country and in other parts it is called poplar.

Two pieces of tulip wood about 18″ long and $\frac{7}{16}$″ square (for pegs for the game board).

One piece of rough white pine 15″x5″x about $\frac{7}{8}$″ (For the swing board).

One piece of butternut 13″x5$\frac{1}{2}$″x$\frac{7}{8}$″ (For the bread cutting board).

One piece of redwood 16″x2$\frac{3}{4}$″x1$\frac{3}{16}$″ (For the coat hanger).

One piece of white pine 13″x1$\frac{1}{2}$″x$\frac{3}{4}$″ (For the cross pieces of the flower-pot stool).

One piece of white pine 9″x1$\frac{7}{8}$″x$\frac{5}{8}$″ (For the feet of the flower-pot stool).

One piece of cypress 19$\frac{1}{4}$″x3$\frac{3}{8}$″x$\frac{5}{8}$″ (For the back of the towel roller).

One piece of cypress 7″x2″x1″ (For the ends of the towel roller).

One piece of cypress 18$\frac{3}{4}$″x1$\frac{1}{2}$″x1$\frac{1}{2}$″ (For the roller of the towel roller).

Four pieces of chestnut 18″x2$\frac{3}{4}$″x$\frac{7}{8}$″ (For the legs of the taboret).[3]

Two pieces of chestnut 14$\frac{1}{2}$″x2$\frac{3}{4}$″x$\frac{7}{8}$″ (For the lower braces of the taboret).[3]

Two pieces of chestnut 14$\frac{1}{2}$″x2$\frac{1}{2}$″x$\frac{7}{8}$″ (For the upper braces of the taboret).[3]

One piece of chestnut 12″x1″x$\frac{5}{8}$″ (For the keys of the taboret).[3]

Two pieces of chestnut 16″x8″x$\frac{7}{8}$″ (For the top of the taboret).[3]

[3] A piece of chestnut 4′ 2″ x 13$\frac{1}{2}$″ x $\frac{7}{8}$″ may be purchased in place of these pieces and cut up as indicated in Chapter VIII.

Two pieces of Norway pine 2′x3¾″x1¾″ (For the main pieces of the clamps).

Two pieces of tulip wood 13″x2½″x1¾″ (For the four blocks of the clamps).

One piece of tulip wood 13″x1¾″x1¼″ (For the two wedges of the clamps).

Four pieces of oak 14″x1¾″x1¾″ (For the legs of the stool).

One piece of hard maple 8½″x1½″x¼″ (For the templet used in testing the mortises).

Two pieces of oak 16″x4¼″x1¼″ (For the longer rails of the stool).

Two pieces of oak 13″x4¼″x1¼″ (For the shorter rails of the stool).

Two pieces of oak 12½″x1½″x⅞″ (For the supports for the seat).

Two pieces of oak 10″x1½″x⅞″ (For the supports for the seat).

Two pieces of oak 14″x1¾″x1″ (For the frame for the cane seat of the stool).

Two pieces of oak 10¼″x1¾″x1″ (For the frame for the cane seat of the stool).

One piece of tulip wood 8″x$\frac{7}{16}$″x$\frac{7}{16}$″ (For the pegs in the seat).

Fifty-five yards of pith cane about $\frac{5}{16}$″ wide for the seat of the stool).

One sheet of No. 1 sandpaper.

One sheet of No. ½ sandpaper.

ne screw hook No. 10 (For coat hanger).

Sixteen 1″ brads (For the flower-pot stool).

Four 1″ No. 10 flat-head bright screws (For the towel roller).

Two 1½″ No. 10 flat-head bright screws (For the towel roller)..

Four 1½″ No. 10 flat-head bright screws (For the taboret).

Twelve 2¼″ No. 14 round-head blue screws (For the clamps).

Twelve ¼″ cut iron washers (For the clamps).

Ten 1½″ No. 10 flat-head bright screws (For the stool).

One bottle of liquid glue with brush.

Two 2-oz. bottles of the strongest ammonia obtainable (For fuming the taboret and stool).

One 2-oz. bottle of fumine (For the stool).

One 2-oz. bottle containing four parts of boiled oil and one part of hard oil finish (For the taboret and stool).

One 1½″ flat paint brush.

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